

04/14/00

Jc490 U.S. PTO

UTILITY PATENT APPLICATION TRANSMITTAL

(Only for new non-provisional applications under 37CFR§1.53(b))

Attorney Docket No. BWD:7116.004

First Inventor or Application
Identifier

DeKOCK, et al.

Title SYSTEM FOR PROVIDING TRAFFIC INFORMATION

Express Mail Label No. EL472157366US

APPLICATION ELEMENTS

See MPEP chapter 600 concerning utility patent application contents.

ADDRESS TO:

Assistant Commissioner for Patents
Box Patent Application
Washington, D.C. 20231

1. ☒ Fee Transmittal Form (e.g. PTO/SB/17)
(Submit an original and a duplicate for fee processing)

2. ☒ Specification

Total Pages

51

- (preferred arrangement set forth below)
- Descriptive Title of the Invention
 - Cross References to Related Applications
 - Statement Regarding Federally Sponsored Research
 - Reference to Microfiche Appendix
 - Background of the Invention
 - Brief Summary of the Invention
 - Brief Description of the Drawings (if filed)
 - Detailed Description
 - Claim(s)
 - Abstract of the Disclosure

3. ☒ Drawing(s) (35 USC 113) Total Pages

15

4. Oath or Declaration Total Pages

3

- a. ☒ Newly executed (original or copy)
- b. ☐ Copy from a prior application (37 CFR §1.63(d))
(for continuation/divisional with Box 16 completed)
- i. ☐ Deletion of Inventor(s)
Signed statement attached deleting inventor(s)
named in the prior application,
see 37 CFR §§1.53(d)(2) and 1.33(b)

5. ☐ Microfiche Computer Program (Appendix)
6. Nucleotide and/or Amino Acid Sequence Submission
(if applicable, all necessary)

- a. ☐ Computer readable copy
- b. ☐ Paper copy (identical to computer copy)
- c. ☐ Statement verifying identity of above copies

ACCOMPANYING APPLICATION PARTS

7. ☐ Assignment Papers (cover sheet & document(s))
8. ☐ 37 CFR §3.73(b) Statement ☐ Power of Attorney
when there is an assignee
9. ☐ English translation document (if applicable)
10. ☒ Information Disclosure ☒ Copies of IDS Citations
Statement (IDS) /PTO 1449
11. ☐ Preliminary Amendment
12. ☒ Return Receipt Postcard (MPEP 503)
(should be specifically itemized)
13. ☒ *Small Entity ☐ Statement filed in prior applica-
Statements tion. Status still proper and desired.
(PTO/sb/09-12)
14. ☐ Certified Copy of Priority Document(s)
(if foreign priority is claimed)
15. ☒ Other - Check for \$504

* Note for Items 1 & 13: In order to be entitled to pay small
entity fees, a small entity statement is required (37 CFR §1.27),
except if one filed in a prior application is relied upon (37 CFR
§1.28)

16. If a CONTINUING APPLICATION, check appropriate box, and supply the requisite information below and in a preliminary amendment

☐ Continuation ☐ Divisional☐ Continuation-in-part (CIP) of prior application No.:

Prior application information: Examiner

Group No./Art Unit

For CONTINUATION or DIVISIONAL APPS only: The entire disclosure of the prior application, from which an oath or declaration is supplied under
Box 4b, is considered a part of the disclosure of the accompanying continuation or divisional application and is hereby incorporated by reference.
The incorporation can only be relied upon when a portion has been inadvertently omitted from the submitted application parts.

17. CORRESPONDENCE ADDRESS

Customer Number or Bar Code Label

(Insert customer number or attach bar code label here)

or ☒ Correspondence address below

Name Bruce W. DeKock

Address 1600 ODS Tower, 801 S.W. Second Avenue

City Portland

State Oregon

Zip Code 97204

Country USA

Telephone (503) 227-5631

FAX (503) 228-4373

Name (print type) Bruce W. DeKock

Registration No. (Attorney/Agent)

40,585

Signature

Date

April 14, 2000

Jc490 U.S. PTO
09/550476

04/14/00

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
PATENT EXAMINING OPERATIONS
PATENT APPLICATION

Applicant : DeKOCK, et al. Group Art Unit:
Serial No.: Examiner:
Filed : (Concurrently Herewith)
Title : SYSTEM FOR PROVIDING TRAFFIC INFORMATION

STATEMENT OF STATUS AS SMALL ENTITY
IN ACCORDANCE WITH 37 CFR §1.27

STATEMENT OF:

I, the undersigned, hereby verify that:

I am:

- [X] one of the inventors of the above-identified invention and I qualify as an independent inventor in accordance with 37 CFR §1.9(c)
- [] an individual assignee/licensee/owner of exclusive/nonexclusive rights in the above-identified invention and I would be classified as an independent inventor in accordance with 37 CFR §1.9(c) if I had made the above-identified invention
- [] the _____ of _____ and have authority to act on behalf of said Company, that said Company qualifies as a small business concern as defined in 37 CFR §1.9(d) in that the number of employees of said Company including those of its affiliates, as defined in 37 CFR §1.9(d), does not exceed 500 persons, and that said Company is the assignee of exclusive rights in the above-identified invention

AND that said I have not assigned, granted, conveyed, or licensed any rights in the invention except to:

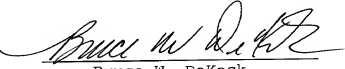
A partnership comprised of four individuals, namely Kevin L. Russell, Bruce W. DeKock, Richard J. Qian, and Wes Okamoto.

AND that I am under no obligation under contract or law to assign, grant, convey, or license any rights in the invention except to:

A partnership comprised of four individuals, namely Kevin L. Russell, Bruce W. DeKock, Richard J. Qian, and Wes Okamoto.

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

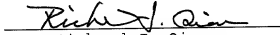
DATED: April 13, 2000


Bruce W. DeKock

DATED: April 13, 2000


Kevin L. Russell

DATED: April 12, 2000


Richard J. Qian

SYSTEM FOR PROVIDING TRAFFIC INFORMATION

The priority date of Provisional Application Serial No. 60/130,399 filed April 19, 1999, Serial
5 No. 60/166,868 filed November 22, 1999, and Serial
No. 60/189,913 filed March 16, 2000 are claimed.

BACKGROUND OF THE INVENTION

10 The present invention relates to a system for
providing traffic information, and more particularly a
system for providing traffic information to a plurality
of mobile users connected to a network.

15 Commuters have a need for information relating
to the congestion and traffic which they may encounter on
a commute over a road, a highway, or a freeway.
Unfortunately, the prior art methods of providing traffic
information to commuters do not allow commuters to
evaluate the extent to which there is congestion on a
highway on which the commuter may wish to travel.

20 One known method of providing traffic information
consists of radio reports. A radio station may broadcast
traffic reports, such as from a helicopter that monitors
traffic conditions over portions of a freeway.
Unfortunately, these reports are usually intermittent in
25 nature. Accordingly, to hear the report, the commuter
must be listening to the radio station at the time the
report is being broadcast on the radio. Further, the
extent of the information provided is severely limited to
broad generalizations. For example, the information
30 provided during the broadcast may be limited to the area
being currently viewed by the reporter, or the
information may be based on a previous view at a prior
time of another portion of the freeway. Some broadcasts
may include multiple observers of different portions of
35 the freeway, yet these systems also provide incomplete
information relating to overall traffic patterns. In
addition, the information provided is vague, subjective,

and usually limited to broad generalities relating to traffic flow.

Another known traffic information system is provided by television broadcasts. In these systems, television stations may mount video cameras pointed at certain portions of a freeway, or may broadcast video images from a helicopter. The television station may periodically broadcast traffic reports and include in the traffic report a view of different portions of the freeway from the video cameras. Again, this system provides little useful information to a commuter. The commuter must be watching the broadcast at the time the information is being transmitted. However, by the time the commuter actually gets into his vehicle and enters a potentially congested area, the traffic may have changed. Further, the information provided is limited to those areas where the traffic is being monitored and may consist of stale information. Often the video image is limited to a small portion of the road, and shows traffic flowing in a single direction.

Yet another method to provide traffic information is to provide a website that is accessible using the Internet that contains traffic information. While these types of systems have the advantage of providing more up to date information, these systems typically provide a map for a large area. Thus, for a person commuting in a car, the system displays traffic information for many areas not of interest to the commuter. In addition, these types of systems require manipulation by the commuter to find the relevant traffic information. For example, while the map may allow the commuter to zoom in on a particular area, the user must provide inputs to the system to instruct the system to zoom in on a particular area. However, a commuter who is actively driving cannot operate a computer and drive at the same time. In addition, these systems may rely on manual entry of data received from subjective traffic

reports and/or traffic sensors. Thus this method may additionally suffer from added cost due to manual labor, incorrect entry of data, and slow response to quickly changing traffic conditions.

5 Fan et al., U.S. Patent No. 5,959,577, disclose a system for processing position and travel related information through a data processing station on a data network. In particular, Fan et al. teach the use of a GPS receiver to obtain a measured position fix of a
10 mobile unit. The measured position fix is reported to the data processing station which associates the reported position with a map of the area. Typically, the measured position of the mobile unit is marked and identified by a marker on the map. The area map is then stored in the
15 data processing station and made available for access by authorized monitor units or mobile units. An authorized monitor unit may request a specific area map. This permits shipping companies to monitor the location of their fleet and permits the mobile units to identify
20 their current location in relation to a map, which is particularly suited for the application of navigation to a particular destination. In addition, Fan et al. teach that the measured position data transmitted from the mobile units may be used to calculate the speeds at which
25 the vehicles travel. The collective speed data from the mobile units is then available for use by the monitor units, such as those at the shipping company, to route the vehicles away from traffic congestions and diversions. In this manner, the dispatcher at the
30 shipping company, to which Fan et al. teaches the data is available to, may use the collective speed data to decide which vehicles to contact in order to reroute them.

Westerlage et al., U.S. Patent Nos. 5,097,377 and 5,987,377, disclose a system for determining a
35 expected time of arrival of a vehicle equipped with a mobile unit.

Zijderhand, U.S. Patent No. 5,402,117, discloses a method of collecting traffic information to determine an origin-destination matrice without infringing upon the privacy of the users.

5 Mandhyan et al., U.S. Patent No. 5,539,645, is related to monitoring movement of traffic along predetermined routes, where individual moving elements can move with a high degree of discretion as to speed except when congestion, accident or the like limit
10 speeds. Mandhyan et al. uses the deployment of calibrant vehicles for collecting and reporting information which describes vehicle speeds actually being experienced along the routes of interest where the data are processed statistically as a function of the time of day. The
15 output provides baseline data against which observations at a particular time, category, weather, event, and location can be compared, to identify the existence of abnormal conditions, and to quantify the abnormality. To determine abnormal conditions, Mandhyan et al. teach the
20 use of probe vehicles. In particular, Mandhyan et al. is applicable to monitoring the flow of motor vehicles along roads which are subject to delays of sufficient frequency and severity that correction action or dissemination of information announcing a delay are economically
25 desirable. Unfortunately, the use of probe vehicles may be expensive and the relevancy of the data is limited to the availability of the probe vehicles.

Lappenbusch et al., U.S. Patent No. 5,982,298, disclose a traffic information system having servers that
30 makes traffic data, images, and video clips available to a user interface on client devices. Lappenbusch et al. envision that the client devices are personal or desktop computers, network computers, set-top boxes, or intelligent televisions. The user interface includes a
35 road map showing a plurality of road segments that a user can interactively select. Vehicular speed information is provided to the system from traffic sensors monitoring

the traffic. In addition, the user interface has a road image area that changes as the user selects different road segments to show recent images of a currently selected road segment. Unfortunately, the system taught by Lappenbusch et al. is complicated to operate and requires significant user interaction to provide relevant data, which is suitable for such "stationary" traditional computing devices.

Smith, Jr. et al., U.S. Patent No. 5,774,827, disclose a system to alleviate the need for sophisticated route guidance systems, where the commuter has a positioning system as well as a map database in a car. A central facility receives and stores current traffic information for preselected commuter routes from various current traffic information sources, such as local police authorities, toll-way authorities, spotters, or sensors deployed on the road ways to detect traffic flow. To achieve the elimination of sophisticated route guidance systems a portable device receives a travel time only for preselected commuter routes from the central facility. In this manner, Smith, Jr. et al. teach that each user receives only the traffic information that is relevant to the user's preselected commuter routes. If desired, the preselected commuter routes may be presented as a set of route segments, where each of the segments is coded to indicate commute time. In response, the user may choose an alternative route known by him that is different from any preselected commuter routes. Smith, Jr. et al. further suggest that a GPS enabled portable unit for transmitting a present position of the portable device to the central facility such that the central facility uses each present position to calculate at least a portion of the current travel information. By matching multiple positions of the portable device with known positions on the preselected route and measuring the time between two consecutive matched positions the central facility can obtain up-to-the minute traffic information to be used in

broadcasting future travel times to other users of preselected commuter routes. Unfortunately, the system taught by Smith, Jr. et al. requires the user to define a set of preselected commuter routes for each route to be traveled, which may be difficult if the user is unfamiliar with the area. In addition, Smith, Jr. et al. teach that the user should select alternative routes that are known to the user, presumably if the commute time of the preselected commuter routes are too long, which is difficult if the user is not already familiar with the area.

Pietzsch et al., U.S. Patent No. 5,673,039, disclose a system for dynamic monitoring of the total traffic in a stretch of road equipped with monitoring and information-provision system, as well as warnings to drivers, and hence the possibility of regulating the traffic. The system does not require that the vehicles be equipped with appropriate sensors and transmitting equipment.

Akutsu et al., U.S. Patent No. 5,987,374, disclose a vehicle traveling guidance system that includes data providing devices laid on a road and a vehicle. The vehicle includes a data transmitter for sending a data providing device traveling data of the vehicle when the vehicle passes over the vicinity of the data providing device and a data receiver for receiving data sent from the data providing device. The traveling data may include vehicle pass time or vehicle pass time and speed. The data providing devices laid on the road include a receiver for receiving the traveling data from the vehicle and a transmitter for sending other passing vehicles the traveling data. A control center communicating through the data providing devices laid on the road can use the received traffic data from the vehicles to predict the occurrence of traffic congestion based on the pass time and speed of a vehicle. It is assumed that at a certain point, vehicles were traveling

smoothly at a certain time and the speed of each vehicle has decreased drastically at the next time. In this case it is expected that traffic congestion will occur in the vicinity of that point. Therefore, smooth travel can be achieved by, for example, communicating to each vehicle data etc. indicating bypasses in order not to worsen traffic congestion. Therefore, a vehicle operator can gain knowledge of the traveling state of a vehicle which has already passed over that point and adjust travel considering traffic flow.

While all of the above systems provide some degree of traffic information for a commuter, nevertheless the above systems do not provide an efficient method of collecting and presenting objective traffic information to a commuter. What is desired, therefore, is a system for providing traffic information which allows a commuter to obtain information at any time desired by the commuter, that provides information relating to a plurality of points along a road, that provides information relating to different traffic levels, that provides information that is particularly relevant to the commuter, and that provides the information in an easily understood format that may be easily utilized by a commuter while driving.

25

BRIEF SUMMARY OF THE INVENTION

The present invention overcomes the limitations of the prior art by providing a system for providing traffic information to a plurality of users connected to a network. In a first aspect the present invention provides a system comprised of a plurality of traffic monitors, each comprising at least a traffic detector and a transmitter, the traffic detector generating a signal in response to vehicular traffic and the transmitter transmitting the signal. The system also includes a receiver that receives the signals from the traffic monitors. A computer system is connected to the receiver

and is also connected to the network. The computer system, in response to a request signal received from one of the users, transmits in response thereto information representative of the signals transmitted by the traffic monitors.

In a second separate aspect of the invention, a system provides traffic information to a plurality of users connected to a network. Traffic is detected at each of a plurality of locations along a road and a signal is generated at each of the locations representative of the traffic at each of the locations. Each of the signals is transmitted from each of the plurality of locations to a receiver. These signals are sent from the receiver to a computer system. The computer system receives a request from one of the users for traffic information. In response to the request, the computer system transmits information representative of the traffic at each of the plurality of locations to the user.

In a third separate aspect of the invention, a system provides traffic information to a plurality of users connected to a network. The system comprises a plurality of mobile user stations, each mobile user station being associated with the display, a global positioning system receiver and a communicating device to allow each of the mobile user stations to send and receive signals. A computer system is interconnected with another communicating device in the network. The computer system is capable of sending and receiving signals to the mobile user stations using the other communicating device in the network. The computer system maintains a map database and a traffic information database. The traffic information database contains information representative of traffic data at a plurality of locations. At least one of the mobile user stations provides a request to the computer system for information together with the respective geographic location of the

mobile user station. In response to the request, the computer system provides to the mobile user station information representative of selected portions of the map database and selected portions of the traffic information database based on the respective geographic location of the requesting mobile user station. The mobile user station then displays graphically on the display information representative of selected portions of the map database and selected portions of the traffic information database.

The traffic information database may be derived from information obtained from stationary traffic monitors, mobile user stations, or a combination thereof. The mobile user station allows traffic information to be displayed in a variety of manners. The display can also show graphically the location of the car on the display. The user may select among different modes for displaying traffic information on the display.

The various aspects of the present invention have one or more of the following advantages. The present invention allows a commuter to obtain traffic information at any time, without waiting for a report to be broadcast. The present invention also allows detailed information relating to traffic conditions based on measurements of the traffic, such as the average vehicular speed or traffic density, to be supplied for a plurality of locations along a road. The invention also allows the convenient display of information in a readily understood form to the user, such as a graphical display.

The foregoing and other features and advantages of the invention will be more readily understood upon consideration of the following detailed description of the invention, taken in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWINGS

FIG. 1 shows a schematic of an exemplary embodiment of a system for providing traffic information.

FIG. 2 shows a front elevational view of an exemplary traffic monitor.

FIG. 3 shows an exemplary display for a user station.

FIG. 4 shows a schematic view of an exemplary embodiment of a mobile user unit of the present invention.

FIG. 5 is a partial electrical schematic for a traffic monitor of FIG. 2.

FIG. 6 is an alternative exemplary display.

FIG. 7 shows a schematic view of another exemplary embodiment of a series of traffic monitors along a road.

FIG. 8 shows another exemplary display for a user station.

FIG. 9 is a flow chart for a method of processing video data to yield traffic information.

FIG. 10 is a flow chart for an alternative method of processing video data to yield traffic information.

FIG. 11 is a schematic representation of a road system having traffic sensors and vehicles at different locations along the road.

FIG. 12 is a combined map and traffic information database representative of the road system depicted in FIG. 11.

FIG. 13 is an exemplary embodiment of a centered display.

FIG. 14 is an exemplary embodiment of an offset display.

FIG. 15 is an exemplary embodiment of a look ahead display.

FIG. 16 is a schematic diagram of a mobile user station having alternative mechanisms for inputting commands to the user station.

5 DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring now to the figures, wherein like numerals refer to like elements, FIG. 1 shows a schematic diagram of the system 10 for providing traffic information to a plurality of user stations 52 connected to a network 50. A plurality of traffic monitors 20 are arranged at spaced apart locations along a road 12. The traffic monitors 20 measure traffic information by detecting the speed (velocity) or frequency of vehicles traveling along the road (freeway or highway) 12. For example, in one embodiment, the traffic monitors 20 may detect the speed of individual vehicles 14 traveling along the road 12. Alternatively, the traffic monitors 20 may measure the frequency with which the individual vehicles 14 pass specified points along the road 12.

FIG. 2 shows a front elevational view of an exemplary embodiment of a traffic monitor 20. The traffic monitor 20 has a detector 22 for measuring or otherwise sensing traffic. FIG. 2 shows two different embodiments 22A and 22B of a detector 22. The detector 22 may be any type of measuring device which is capable of measuring or otherwise sensing traffic and generating a signal representative of or capable of being used to determine the traffic conditions. For example, the detector 22 could measure the average speed of the vehicles (cars or trucks) 14 at locations along the road 12, or it could measure the individual speed (velocities) of each vehicle 14. The detector 22 may detect vehicle frequency, that is, the frequency at which vehicles pass a certain point, or may measure traffic flow, consisting of the number of vehicles passing a certain point for a unit of time (e.g., vehicles per second). The detector 22 may use any suitable technique to measure traffic

conditions (data). For example, in one embodiment, the detector 22A could employ radio waves, light waves (optical or infrared), microwaves, sound waves, analog signals, digital signals, doppler shifts, or any other type of system to measure traffic conditions (data). In one embodiment, the detector 22A uses a transmitted beam to measure the velocity of the vehicles 14 passing along the road 12, such as with a commercial radar gun or speed detector commonly used by police. Alternatively, the detector 22A may detect when cars having magnetic tags or markers pass. The detector 22A may either detect signals reflected from the vehicle or signals transmitted by the vehicles.

The traffic monitor 20 is shown with an alternative embodiment 22B consisting of one or more pressure sensitive detectors which extends across the road 12. Preferably two spaced apart detectors are positioned at a predetermined spacing to make the velocity determination readily available. The pressure sensitive detector 22B detects when a vehicle passes over the detector 22B. Such a pressure sensitive detector may be used alone or in combination with detector 22A to measure the frequency or speed (velocity) of the traffic passing along the road 12. Likewise, the detector 22A may be used alone or in combination with the detector 22B to measure the frequency or speed (velocity) of the traffic passing along the road 12. Alternatively, detector 22B could be a wire loop buried in the road to measure changing magnetic fields as vehicles pass over the loop.

The detector 22 may measure traffic conditions in a single lane of a freeway or road, or may measure average traffic information across several lanes. The detector 22 could also be embedded in each lane of a road or freeway, such as with a pressure sensitive detector 22B. Alternatively, individual detectors could be embedded in a roadway which would sense signals or

conditions generated by passing vehicles. For example, each vehicle could include a magnet or could include a signaling device which would be detected by the detector, which could be an electromagnetic sensor or a signal receiver.

Referring to FIG. 5, the traffic monitors 20 may also include a processor and a memory for collecting, processing, and storing traffic information provided by the detector 22.

The traffic monitor 20 preferably further includes a transmitter 26 for transmitting the traffic information collected by the detector 22. The transmitter 26 may be any type of device capable of transmitting or otherwise providing data in either digital or analog form, either through the air or through a conductor. For example, the transmitter could be a digital or analog cellular transmitter, a radio transmitter, a microwave transmitter, or a transmitter connected to a wire, such as a coaxial cable or a telephone line. The transmitter 26 is shown as transmitting the signals through the air to a receiver 30. Alternatively, the transmitter 26 could transmit the data to an intermediate receiver before being transmitted to the receiver 30. For example, several traffic monitors 20 could transmit traffic information in a daisy chain manner from one end of a road 12 to the last traffic monitor 20 at the other end of the road before being transmitted to receiver 30. To facilitate this type of transmission most traffic monitors 20 would require a receiver. Alternatively, one or more traffic monitors 20 could transmit data to other traffic monitors 20, which in turn transmit the data to the receiver 30. In order to conserve power, the transmitter 26 and the detectors 22 preferably transmit and sense information periodically rather than continuously. Further, the traffic information generated by the detector 22 is preferably averaged, or otherwise statistically modified,

over a period of time so as to limit the amount of data that needs to be transmitted and increase its accuracy.

In one embodiment, the traffic monitoring unit 20 may further include a video camera 29. The video camera 29 is also connected to the transmitter 26, so that the transmitter 26 may transmit signals corresponding to the image sensed by the video camera 29. Alternatively, the traffic monitors 20 may be replaced by video cameras 29. Multiple images may be obtained by a video camera and the speed of the vehicles 14 determined based on image analysis of multiple frames from the video camera(s).

One preferred type of monitor 20 utilizes signals from a digital video camera to provide the traffic information. Traffic-related information may be obtained by analyzing the video sequences from the monitoring video cameras 29. The information may include how fast the traffic moves and how congested the road is. The speed of the traffic may be derived by measuring the speed of vehicles in the video. The degree of congestion may be estimated by counting the number of vehicles in the video. This invention provides two algorithms for estimating traffic speed and road congestion based on video input.

The first algorithm is based on optical flow and its flow diagram is shown in Figure 9. First, the algorithm performs camera calibration based on the input video of the road and the physical measurements of certain markings on the road. Then the algorithm (1) takes a number of frames from the input video; (2) computes optical flow; (3) estimates camera motion which may be caused by wind, etc., (4) estimates independent vehicle motion after compensating the camera motion; (5) estimates traffic speed based on the averaged vehicle motion and the camera parameters obtained from the camera calibration step; estimates road congestion by counting

the number of independent motion components; and (6) outputs the estimated speed and congestion results.

The second algorithm is based on motion blob tracking and its block diagram is shown in Figure 10.

- 5 First, the algorithm performs camera calibration based on the input video of the road and the physical measurements of certain markings on the road. The algorithm (1) takes a number of frames from the input video; (2) estimates camera motion; (3) detects independent motion blobs after
- 10 compensating the camera motion; (4) tracks motion blobs; (5) estimates traffic speed based on the averaged blob motion and the camera parameters obtained from the camera calibration step; estimates road congestion by counting the number of independent motion blobs; and (6) outputs
- 15 the estimated speed and congestion results.

- Traffic monitor 20 further includes a power supply 24. The power supply 24 is preferably a battery, or may alternatively be a power line, such as a 12 or 120 volt power line. The traffic monitor 20 is shown with an
- 20 optional solar power supply 28. The power supply 24 or 28 provides the power necessary for the detectors 22A and/or 22B, the transmitter 26, and any other electronics, such as a computer system and/or video camera.

- 25 The receiver 30 receives the signals from the traffic monitors 20 and/or video cameras 29. The receiver 30 may be any device capable of receiving information (data) such as in either an analog or a digital form. For example, the receiver 30 may be a
- 30 digital or analog cellular receiver, a standard phone, a radio receiver, an antenna, or a data port capable of receiving analog or digital information, such as that transmitted pursuant to a data protocol.

- 35 The receiver 30 receives the information from the traffic monitors 20 and/or video cameras 29 and passes that information to a computer system 40. The computer system 40 preferably includes a processor (such

as a general purpose processor, ASIC, DSP, etc.), a clock, a power supply, and a memory. The computer system 40 preferably has a port 42, or any type of interconnection, to interconnect the computer system 40 with the network 50. Preferably, the computer system 40 includes information representative of the road 12 along which the traffic monitors 20 are located, such as a map database. The computer system 40 receives the traffic information transmitted by the respective traffic monitors 20. The information transmitted by the traffic monitors 20 includes the location or identification of each particular traffic monitor 20 together with the data representative of the traffic data provided by the detector 22 and/or video camera 29 at each traffic monitor 20. The computer system 40 may manipulate the traffic information in some manner, as necessary, so as to provide average speeds or other statistical data. In the event of video, the computer system 40 may process the images to determine the speed of vehicles. Also, the video may be provided. Alternatively, the user stations may process the traffic information.

In one embodiment, both the receiver 26 of the traffic monitors and the transmitter 30 of computer system are each capable of receiving and transmitting data. This allows for two way communication between the monitor 20 and the computer system 40. Thus, the computer system 40 could remotely operate the traffic monitor 20 to change settings, diagnose problems, and otherwise provide input to traffic monitor 20 to facilitate collection of traffic data. For example, the video camera 29 could be remotely positioned to view a traffic lane of interest.

Traffic information may be provided to users in any suitable manner, such as the examples that follow. A user station 52 is connected to the network 50. Preferably, the user station 52 includes a graphic display unit 54 (see FIG. 3). For example, the user

station 52 may be a standard personal computer with a display monitor 54. The network 50 is preferably the Internet. However, the network 50 could also be a local area network or any other type of closed or open network, or could also be the telephone network. The user station 52 sends a signal over the network 50 to the computer system 40 requesting traffic information. In response to receiving a request from the user station 52, the computer system 40 transmits traffic information representative of the traffic information collected by the various traffic monitors 20 to the requesting user station 52. The computer system 40 may transmit average speeds detected by each of the traffic monitors 20 at each of their respective locations. The traffic information may be presented to the user as a web page. The computer system may send traffic information corresponding to only some of the traffic monitors. The user may select which portions of the road 12 are of interest, and the computer system 40 may transmit traffic information corresponding to that portion of the road 12.

FIG. 3 shows an exemplary display 54 displaying the traffic information provided by the computer system 40. The computer system 40 provides data from its memory which is representative of the road 12, such as data from a map database, which is displayed as a road 112 on the display 54. The computer system 40 also provides traffic information collected by each, or a selected set, of the respective traffic monitors 20 which is displayed in portions 114a-114d and/or the traffic information derived from individual mobile user stations having a global positioning system locator as described in detail below. In the exemplary display shown in FIG. 3, the portions 114a-114d display different colors or patterns representative of average vehicle speeds (for example, in miles per hour) along different portions of the road 112. Of course, the display may display other types of information, such as traffic flow (vehicles per second)

or vehicle frequency. The display 54 may include information in either graphical or text format to indicate the portion of the road displayed, such as location of milepost markers or place names 116.

5 While the display 54 shows one format for displaying the information, other formats for presenting the information may likewise be used, as desired. It is not necessary to provide a graphical representation of the road 12. Instead, information could be provided in a
10 textual manner, such as, for example, mile post locations for each of the traffic monitors 20 and presenting textual traffic information for each location.

Thus, the system may operate as follows. The traffic monitors 20 detect or otherwise sense traffic to
15 provide traffic information. The traffic monitors 20 may detect or otherwise calculate vehicle speed, average vehicle speed, traffic flow, vehicle frequency, or other data representative of the traffic. The traffic monitors 20 may sample either continuously, or may sample at
20 intervals to conserve power. The transmitter 26 transmits the signals provided by the traffic monitors 20 to the receiver 30 either continuously or at intervals. Such signals may be either transmitted directly to the receiver 30, or may be transmitted through other traffic
25 monitors 20. The receiver 30 receives the signals received by the various traffic monitors 20 and passes these signals to the computer system 40. The computer system 40 receives the data from the traffic monitors 20. The computer system may calculate or process the traffic
30 information for the users, as necessary. It is not necessary for the traffic monitors 20 to calculate traffic data, if desired. In response to a request from a user station 52, the computer system 40 provides the traffic information over the network 50 to the user
35 station 52.

The system 10 has many advantages. It allows a user to receive contemporaneous traffic information from

a plurality of locations. It allows the user to obtain immediate information rather than waiting for the broadcast of information at specified times. Further, the amount of information provided by the system is far superior to that provided by any other traffic reporting system. A user can obtain immediate and contemporaneous traffic conditions, such as average vehicular speed, traffic flow, or vehicle frequency, for a plurality of locations along a road. Where traffic monitors are provided along several different roads, a commuter may then select among the various alternative routes, depending on the traffic conditions for each road. The system also does not rely on the manual input of information, and thus provides information more accurately and more quickly. It also eliminates subjective descriptions of traffic information by providing measured data representative of traffic conditions.

In one embodiment, the computer system 40 also receives the signals generated by the video cameras 29 at the respective traffic monitors 20. FIG. 3 shows an exemplary display 54 in which a video image 129 is provided. In this embodiment, the user may select from which traffic monitoring unit 20 the video image 129 is to be received from. For example, a user could initially select to view the image generated by the video camera at a first location, and then later view the image transmitted by another video camera 29, preferably at another traffic monitor 20, at a different location.

The system 10 preferably further includes the ability to send messages about road conditions. FIG. 3 shows such an exemplary message 130 in text format. The computer system 40 is capable of storing data messages and transmitting the data messages with the traffic information. The data messages would indicate items of particular interest to the commuter. For example, the text message 130 could indicate that there was an

accident at a particular location or milepost, that construction was occurring at another location or milepost, or that highway conditions were particularly severe and that alternative routes should be selected.

- 5 The system 10 could provide multiple messages through which the user could scroll so as to receive different messages in addition to the traffic information received from the various traffic monitors 20. In another embodiment, the user station 52 includes a voice
10 synthesizer capable of reading the messages to the user.

- In yet another embodiment, the system 10 may also provide additional graphical information relating to traffic conditions. For example, the computer system 40 could transmit the location of an accident or
15 construction site along the road 12. The information would be displayed on display 54 as an icon or other symbol at the location indicating the presence of an accident or highway construction. Such an icon is shown at 140 in FIG. 3. Alternatively, the computer system
20 could also display an icon representative of a restaurant, gas station, hospital, rest area, or roadside attraction. In such a system, the computer system would contain or be linked to a database containing such information. The information could be displayed
25 automatically, or in response to a request for such information from a user.

- In another exemplary embodiment, the computer system 40 automatically generates traffic reports to be sent to the user station 52 at predetermined times. For
30 example, a user may indicate that it wishes to receive a traffic report every morning at 7:30 a.m. The computer system 40 automatically sends to the user station 52 at the predetermined time (7:30 a.m., for example) the traffic information collected from the traffic monitoring
35 units 20. The information could be sent to be displayed, such as in FIG. 3, or could be sent alternatively in a text or graphical format via e-mail. The traffic report

may also be provided in a format specific to the user's geographic region and/or user's driving habits, such as anticipated (potential) route to be traveled. The computer system 40 may also automatically send the

5 traffic information to a display in the user's vehicle in response to some event, such as turning on the vehicle, time, key press, etc.

In another embodiment, the computer system 40 allows a user to calculate the amount of time necessary

10 to travel from one location to another location along the road 12. The user sends a request to the computer system 40 indicating the two locations along the road along which travel is desired. The user may, for example,

15 indicate on the display by highlighting the two locations on the road 112 using a computer mouse. Alternatively, the two locations may include the user's current location, as determined by a vehicle based GPS system, so that only the destination needs to be entered. The computer system 40 then calculates the anticipated amount

20 of time it will take to travel from one point to the other point based upon the traffic data collected by the various traffic monitors 20 between the two locations. In addition, the system may calculate alternative routes in order to determine the fastest route in view of the

25 traffic information. The computer system 40 then sends a signal back to the user station 52 to indicate the amount of time that the travel from the first to the second location will take. The route determined as the best may be overlaid on a map to assist the user in travel.

In yet another embodiment of the invention, FIG. 7 shows a divided freeway with vehicle traffic flowing in opposite directions in each of the divided sections. Each section of the freeway 12 has multiple lanes 12A-12C. The traffic monitors 20 measure traffic

35 in each of the lanes 12A-12C of each section 12 of the divided freeway. The monitors 20 may measure traffic on only one portion of the divided freeway, or may measure

traffic conditions in each of the lanes of each of the sections of the divided freeway. The monitor used to measure traffic in multiple lanes may be a digital video camera.

5 FIG. 8 shows yet another embodiment of a display 54, which displays traffic information for each individual lane of the divided freeway shown in FIG. 7. For example, in display 54, the traffic conditions in each individual lane 112A-112C is displayed for the road
10 section 112. By displaying conditions for each particular lane, the system has the advantage of allowing the user to anticipate particular lane problems which may occur ahead, such as a wreck 140 in lane 112C. In addition, in an alternative embodiment, the display 54 is
15 capable of displaying the individual location of each individual vehicle on the road 112.

FIG. 4 shows an alternative embodiment of a user station 52. User station 52 is a mobile unit in a car 60. User station 52 has transmitting and/or
20 receiving units 64 for communicating with the network 50. Such transmitting and receiving units 64 may be any devices capable of transmitting digital or analog data, such as, for example, a digital or analog cellular phone.

The user station 52 may also be contained
25 within a car 60 that further includes an associated global positioning system (GPS) receiver 62. The GPS receiver 62 receives signals from GPS satellites 70 which enable the GPS receiver to determine its location. When a commuter requests traffic information using the mobile
30 user station 52, the request for traffic information may include the location of the user as determined by the GPS receiver 62. When the computer system 40 receives this request, it provides traffic information back to the mobile user station 52 based on the location of the car
35 60 as provided by the GPS receiver 62. Alternatively, the computer system 40 may provide traffic information to the user station 52 which in combination with the

position determined by the GPS receiver 62 displays suitable data to the user on a display or audibly. The user station may also be a cellular phone with an integrated or associated GPS.

5 FIG. 6 shows a representative display of the traffic information provided by the computer system 40. The information provided is essentially the same as that shown in FIG. 3, except that the display 54 contains at 161 the position of the car 60. The mobile user station 10 52 provides a significant advantage in that it allows the commuter to immediately determine traffic information in the commuter's immediate vicinity based on the commuter's present location. The commuter does not have to wait for a periodic traffic report. Further, traffic conditions 15 are provided at a plurality of locations, and the information is contemporaneous. Based on the receipt of such information, the commuter may decide to use an alternate route rather than continue on the current freeway.

20 Thus, in the embodiment shown in FIG. 4, the system provides the relevant traffic information to the commuter or user on a timely basis. The display may be tailored to provide the information for the current location of the commuter, together with the upcoming 25 traffic that lies ahead.

In a preferred embodiment, the system obtains traffic information from users that have a GPS receiver 62. In this system, whenever a user station 52 requests traffic information from the computer system 40, the 30 computer system 40 associates a velocity (speed) of that particular user with its current location. The velocity may be determined through a variety of methods. In one system, when the user requests traffic information, the user station 52 supplies not only its location but also 35 its current velocity. The user station 52 may obtain its current velocity in any fashion. For example, the user station 52 may track its location over time using the GPS

receiver 62, and also keep track of the time associated with each location by using an internal clock. The velocity could then be calculated by simply dividing the difference between respective locations by respective times. Alternatively, the user station 52 may be connected to the vehicle's speedometer or odometer, and measure velocity using information provided by the vehicle 60 itself. Alternatively, the computer system 40 itself could calculate the velocity of each user. In such a system, each user station 52 would provide the computer system 40 with a unique identification code together with its location. The computer system 40 then associates a time using an internal clock with each location reported by each user. Preferably, the GPS location is sent together with the current time at the user station so that delays incurred in transmission do not change the result. The velocity of each user could then be calculated by calculating the difference in location for a particular user (identified by its unique identification code) by the respective times associated with each of these locations.

Thus, the computer system 40 develops a database consisting of the location of a plurality of users together with the respective velocities of each of the users. The computer system 40 thus has traffic information consisting at least of the velocity of the traffic for a plurality of locations corresponding to the locations for each of the reporting users. It is preferred in such a system that each user station 52 would contribute to the database, but the computer system could use data from fewer than all of the user stations 52 either requesting information or operating. The system may thus use the information received from the user stations 52 either to calibrate the traffic information provided by monitors 20, or to supplement the traffic information provided by the traffic monitors 20. Alternatively, where the number of users is sufficiently

large, the traffic monitors 20 may no longer be necessary, because the users themselves through mobile user stations 52 and GPS receivers 62 provide enough traffic information to generate useful displays of traffic information. Thus, the system may provide traffic information without the use of monitors 20 at all, relying solely on information derived from the mobile user stations 52. With a large number of users at a plurality of different locations, the computer system 40 would develop a database having a large number of velocities associated with a large number of geographic locations. Ideally, if every commuter on a road had a user station 52 with a GPS receiver 62, the computer system 40 would provide not only velocity data but also traffic density or traffic frequency data. Even without every vehicle having a user station 52 providing data to the computer system 40, traffic density or traffic frequency could be calculated using statistical techniques that correlate the reporting user stations 52 with known traffic patterns.

Thus, the combination of the mobile user station 52, GPS receiver and transmitting and receiving units 64 provides an especially advantageous method for collecting traffic information. Surprisingly, this system is capable of providing traffic information that is superior to that collected by stationary sensors. This is because traffic information may be potentially collected at more locations based on the number of mobile user stations 52, and because individual vehicle speed can be monitored rather than average vehicle speed. In addition, the system has a significant cost advantage in that it is not necessary to install traffic monitors 20, or at least the number of traffic monitors 20 that are necessary can be substantially reduced. The system also provides automatic traffic reporting, and thus does not rely on the manual input of data. Furthermore, the system is low maintenance, since there are no traffic

monitors 20 to maintain. The system is also particularly robust, in that if a particular mobile user station 52 malfunctions, traffic information can still be collected for all locations based on data reported by other mobile users. In contrast, if a stationary sensor 20 fails, no data can be collected from that location. Thus, the collection of traffic data from a plurality of mobile user stations 52 to create a traffic information database provides surprising advantages and a superior system for providing traffic information.

In the system described above using mobile user stations 52 in vehicles, the user station may initiate contact with the computer system 40 by initiating a telephone call to the computer system 40. Alternatively, the computer system 40 could initiate a call to the user station 52, such as over the Internet using a web browser. The user station 52 would respond with an appropriate signal if information was requested. The user station 52 could also, even if no information was desired, provide its current location (preferably with current time), and optionally its velocity as well, to allow the computer system 40 to gather additional traffic information. This would be useful in the case of vehicle based Internet browsing for other purposes so that the traffic information would be updated for that user and others. In yet another alternative, the user station 52 would initiate the request to the computer system 40, indicating that traffic information was desired. The computer system 40 would then respond at a series of timed intervals for a set length of time, for example, providing updates every two minutes for thirty minutes.

In yet another alternative embodiment of the system 10, the mobile user station 52 is a cellular telephone. The computer system 40 includes a voice synthesizer. A user may telephone the computer system 40 over a cellular telephone network. In response to a request for highway conditions, the computer system 40

generates a traffic report and transmits the information using the voice synthesizer so that the traffic information may be heard and understood over the commuter's cellular telephone. The location of the user may be determined by an associated GPS receiver, or alternatively by triangulating the location of the user by measuring the distance between the user and several different transmission receiving towers in different cells.

In yet another embodiment of the present invention the computer system 40 or user station 52 may calculate the best route, such as the fastest, between a starting point and a destination based on the current traffic conditions. This functionality may further be provided in the mobile user station 52 in the car 60 so that the driver may calculate the best route to accommodate for changing traffic conditions. This also assists the driver in unfamiliar cities where he may be unfamiliar with anticipated traffic patterns. The functionality of providing current traffic conditions and/or best route calculations may be overlaid on maps available for GPS systems, household computers, and mobile user stations.

In addition, an early warning system may be incorporated into the computer system, user station, or mobile user station to provide warning of impending traffic jams, such as the result of a traffic accident. For example, if the average vehicle speed on a portion of a road ahead of a driver is less than a preselected velocity, such as 25 mph, the computer system 40 may send a warning signal to the mobile user station 52. Alternatively, a velocity less than a preselected percentage or other measure of the anticipated velocity for the particular road may be used as the warning basis. It is also envisioned within the scope of the invention that data communications may be accomplished using radio broadcasts, preferably encoded in some manner.

Preferably, the computer system 40 and/or the mobile user station 52 in a vehicle 60 has stored in its associated memory a map database representative of the road or highway network that contains longitude and latitude information associated with various geographic locations on the map. This allows easy integration of traffic data that has associated longitude and latitude information. For example, along a particular section of a highway, the map database contains the latitude and longitude of selected locations of the highway. The latitude and longitude of the various traffic sensors 20 may be predetermined. When data representative of the traffic at a particular sensor 20 is received, the computer system 40 can easily display the traffic information for that particular location on the map by associating the geographic location of the sensor 20 with the longitude and latitude information contained in the map database. Similarly, where traffic information is derived from individual mobile user stations 52 in vehicles 60 which report latitude and longitude derived from the mobile GPS receivers 62, the computer system 40 can easily associate the traffic information received from the mobile user station 52 with the map database based on the user's reported latitude and longitude. Thus, by utilizing a map database that contains latitude and longitude information for various locations, the system can easily overlay traffic information on top of the displayed map data by associating the geographic data (latitude and longitude) corresponding to the traffic information with the geographic data corresponding to the map.

FIGS. 11 to 12 illustrate such a system. FIG. 11 shows schematically a section of a road having various locations 201-218. Along the road are positioned various sensors 20a-20d whose geographic locations have been determined. Traveling along the road are a variety of users 401-404 having respective user stations and GPS

receivers. FIG. 12 illustrates one embodiment of a map and traffic information database that may be developed to provide traffic information over the network to individual users. Each of the various locations (or road segments) 201-218 has an associated longitude and latitude. In addition, the database may optionally contain the associated road, as well as optionally the direction that traffic moves at that location (for example, using a 360 degree compass, 0 degrees would represent straight north while 90 degrees would represent straight east). The database also includes traffic information, such as the average vehicle velocity calculated for that location. Thus, for example, referring to FIG. 11, the traffic monitor 20a may be used to provide the vehicle velocity for location 202. User 401 may be used to provide the vehicle velocity at location 210.

Of course, while a database has been illustrated that combines both map and traffic information, the system could use two or more databases containing portions of the information, such as a separate map database and a separate traffic information database. An example of a map database useful with such a system is Etak Map® from SONY®. The map database could reside on either or both the computer system 40 or the mobile user station 52.

When a user requests traffic information from the computer system 40, the computer system 40 transmits the requested data based on either the geographic location of the user, or for the geographic location requested by the user. The computer system 40 either sends the raw traffic data requested by the user, or sends a signal representative of the map and/or traffic database which may be used by the user station 52 to represent the map and traffic information on the display 54.

The advantage of using a map database that contains longitude and latitude information associated with various locations on a map is that the system allows easy and automatic integration of traffic information, either to a database or for display. Thus, traffic information may be collected from an individual user who provides the longitude and latitude for that user based on information derived from the user's GPS receiver 62. The computer system then matches the location of the user to the map database based on the received longitude and latitude information. The computer system 40 can then overlay the traffic information data received from the user onto the map database based upon the provided longitude and latitude information. Thus, the system allows traffic information to be updated for a map database, even though the routes of the individual users are not predetermined. In other words, it is not necessary to know the particular route of an individual user in order to collect useful traffic information and to update a traffic information database.

The traffic information database may be configured to provide traffic information to optimize the analysis of traffic information both by location and time. The spacing of the locations for which traffic information is associated may be either every half-mile, mile, etc. The spacing depends on the locations of ground based traffic monitors and the number of cars traveling through a particular spacing. If, for example, there are traffic monitors spaced every half-mile, then the traffic information database may report traffic information for each of those locations. However, for a section of road that does not have traffic monitors, the spacing of the locations associating traffic information depends on the frequency of vehicles passing along the highway and which are reporting traffic conditions. For example, where the traffic density is high, there will be a large number of vehicles from which to gather data, and

accordingly the spacing between locations may be small, such as 1/4 mile. However, where the traffic density is low, there may be few vehicles from which to gather data, and thus the spacing may be large, such as 3 miles. The traffic information database may be configured so that the spacing is optimized based on the ability to collect data for different areas. Thus, for a section of freeway in a congested area, the spacing of locations for traffic information may be short, such as 1/4 mile, while in outlying areas the spacing may be large, such as every three miles.

Similarly, the amount of time over which data is collected and averaged may be varied. Ideally, the traffic information presented represents traffic conditions at that moment in time. However, it may be necessary to collect data for a length of time in order to gather enough data to either report any traffic information at all, or to insure that the traffic information is truly representative of conditions at that location. Where traffic density is high, the length of time over which data is collected and used to determine traffic conditions may be short, for example three minutes. In contrast, where traffic levels are light, data may be collected for a long period of time, such as fifteen minutes. When used to determine traffic information, the data may be averaged over the period for which data has been collected. Alternatively, the traffic information could be weighted, so that older traffic information, though used, is given less weight when determining traffic information for a particular location.

By varying the spacing between locations for which data is associated in the database and the length of time over which information is collected, the database may be configured to optimize the collection and presentation of traffic information. For areas with high traffic density, the data may be gathered over a short

period of time, and the spacing between locations may be small. For areas with low traffic density, the data may be gathered over long periods of time and the spacing may be large. The database may be configured as traffic conditions change, so that during periods of congestion the information is gathered only over a short time for a particular area, while during periods of freely flowing traffic, the information is gathered over a longer time for the same area.

10 The present invention provides several alternative methods for displaying traffic information to a commuter using a mobile user station 52. These various alternatives allow the user to customize the display 54 to provide the desired information, and to minimize the amount of operation needed while driving. In one display embodiment, the display 54 centers the location of the user on the displayed map, and is referred to herein as the "Centered Display." In the Centered Display, the mobile user station 52 determines the longitude and latitude of the commuter based on information obtained from the GPS receiver 62. The mobile user station 52 then displays the position of the commuter at the center of the display 54 as shown in FIG. 13. The traffic information and roadway data is then displayed around the commuter by comparing the longitude and latitude of the user with the longitude and latitude associated with the various map locations contained in the map database. The individual user may preselect the scale of the map which will be displayed based on the user's preference. For example, the user may wish to show an area of one mile radius centered around the user, or two mile radius, or so forth. As the user drives along a road and the user's geographic location changes, the user station 52 and/or computer system 40 adjusts the display 54 to reposition the map and traffic information on the display 54. Thus, the map and traffic information scroll along the display 54 as the user moves along a road. For example, if the

display 54 shows map and traffic information at a scale of one inch per mile and the direction north is shown at the top of the display, the map and traffic information would scroll down one inch as the user drives one mile north. The display 54 would continuously show the location of the user at the center of the display 54 even though the geographic location of the user changes.

A particular advantage of the Centered Display as discussed above is that the location of the user can immediately be ascertained from a quick glance at the display 54, because the location of the user is always at the center of the display 54. The user is not required to adjust the display 54 by inputting information to the user station 52 in order to constantly view the surrounding traffic information, even as the location of the user changes. Thus a commuter, by selecting the Centered Display, may view constantly updated traffic information for his location without requiring any input from the commuter.

Alternatively, the display may be preselected to show the location of the user at a different location on the display 54, but that continues to show the geographic location of the user at a single location on the display 54, even as the geographic location of the user changes. This is referred to as an "Offset Display." This is a variation of the "Centered Display," but allows the user to adjust the display 54 to show more information of interest to the user. For example, if the user is traveling north, and north is shown at the top of the display 54, the user may choose to display his location near the bottom of the display (offset from the center) so as to display a greater amount of traffic information in the northern direction. Such a display is shown in FIG. 14. Like the "Centered Display," as the geographic location of the user changes, the map and traffic information is automatically scrolled to show the surrounding road and traffic, while maintaining the

location of the user on the display 54. The "Offset Display" is particularly suited for driving along a relatively straight road, so that the user has relatively more upcoming traffic information displayed.

5 Yet another alternative display allows the user to display upcoming traffic information for the road on which the user is traveling, referred to herein as the "Look Ahead Display." In the Look Ahead Display, the display 54 displays the location of the user near an edge
10 of the display 54 so as to maximize the amount of upcoming road and traffic information which is displayed. In the Look Ahead Display, the computer system 40 and/or the user station 52 determines the direction of the user based on data received from the GPS receiver 62 and
15 compares that direction to the road the user is traveling on. The map and traffic information is then selected so as to maximize the amount of road shown ahead of the driver. The user may select to either display the map and traffic information so that the cardinal ordinates
20 North, South, East and West remain fixed (for example North is always at the top of the display) or the road is generally centered (for example vertically on the display) without regard to the cardinal ordinates. For example, when the display maintains North at the top of
25 the display, and the user is traveling south, the display 54 would display the location of the user near the top of the display 54, so as to increase the amount of the road ahead of the user that is displayed. If the road then curved, so that the user was heading in an easterly
30 direction, the display 54 would show the location of the user near the left hand side of the screen so as to display the road ahead to the east (east appearing on the right hand side of the screen). This is illustrated in FIG. 15. By constantly comparing the direction of
35 movement of the user, as determined from the data received from the GPS receiver 62, with the road information contained in the map database, the system

maximizes the amount of map and traffic information displayed based on the location and direction of travel of the user.

Yet another type of display is the "Stationary Display." In this type of display, the underlying map data remains "motionless" while the displayed location of the user changes according to the movement of the user. For example, initially, the user's geographic location on the map may be shown at the center of the screen. As the user moves along a road, the user's location would change on the display 54, while the position of the road relative to the screen would remain constant. (An example of such a display is shown in FIG. 6). If the user moved to a location not displayed, a new map would be displayed, showing the location of the user on the new map screen. The Stationary Display is useful where the map database is divided into discrete units that roughly correspond to "pages." The Stationary Display can show the map data corresponding to a particular page on the display 54. New pages can be shown as the user's location changes. The Stationary Display may be preferred where the user is familiar with the surrounding area. The Stationary Display may also be less disconcerting to the user, because only a small portion of the screen is changing (the displayed location of the user) as the user's geographic location changes. The Stationary Display may also achieve some efficiencies for the system, because the computer system 40 would only be required to send enough data to fill display 54 to show the map for the area surrounding the location of the user and then update as necessary for new traffic information. Thus, the map database could be divided into discrete portions, each portion containing enough information to fill a display. In response to a request from a mobile user station 52 providing location information derived from the GPS receiver 62, the computer system 40 identifies the corresponding portion of the map database

to the user station 52. The user station 52 may manage the task of integrating the map database with the user's location to display the geographic position of the user. New map data would only be sent if the user's geographic location changed enough so that a different portion of the map database corresponds to the new location.

Yet another mode for displaying map and traffic information is to display a particular area of interest (referred to as the "Area Display"). The Area Display displays a particular geographic area of interest to the commuter. The location of the commuter may or may not be displayed, depending on whether the commuter is located within the area. To receive an Area Display, the mobile user station 52 transmits the location of the area of interest, and in response, the computer system 40 provides pertinent map and/or traffic information. The Area Display may be especially advantageous where the commuter wishes to view a particular area of interest that may be some distance away from the commuter.

Typically the maps may be displayed with different amounts of detail, freeways, highways, parks, arterials, side streets, etc., which may be selected by the user. The amount of road detail provided for a particular region may be associated with the map provided and the technique of presentation to provide additional ease of use.

Various alternatives may be used to command the user station 52 and/or computer system 40 to display map and traffic information. In one embodiment, where the network is the Internet, the system may provide a settings preference web page to the user to allow the user to select the user's individual display settings. Thus, the user may select the scale of the display (i.e. one inch of display equals one geographic mile); the size of the display (to accommodate different screen sizes); the frequency at which the map and traffic information is updated; the particular default display type (such as the

"Centered Display," "Look Ahead Display," "Stationary Display," "Area Display," or other type); and whether information banners are to be displayed. The ability to choose the frequency with which traffic information may be updated may be useful to allow the user to control the cost of providing the information to the user. For example, where the cost of being connected to the network is high, the user may wish to receive only short periodic updates (such as an update every five minutes) to reduce the expense of receiving data.

The user may also set the time duration for which the traffic information is displayed to the user. The user may choose, for example, to alternate between the traffic information web site, and another web site. Thus, the computer system 40 may transmit traffic information for 30 seconds, and then may transmit information such as stock quotes from another web site for 30 seconds.

In addition to default settings, or settings that are preset by the user, the user station 52 may be capable of receiving input from the user to actively change how information is displayed in response to user commands. In one embodiment, the user station 52 includes a microphone 53 and voice recognition software to allow the user station 52 to respond to the voice commands of the user. (See FIG. 16). Thus, the user may by using verbal commands select a particular mode of display, request an update of the traffic information, or change the scale of the map. Alternatively, the user station 52 may have a keyboard to accept input commands via the keyboard. Alternatively, the user station may have only a control panel 55 having several key pads 57 which correspond to particular types of preset commands. For example, one key pad may allow a user to request traffic information. Another key pad may allow a user to zoom in on the map (i.e. change scale to show more detail), while another key pad would cause the display to

zoom out (i.e. change scale to show more area). Another key pad may select for the Stationary Display, while yet another may select for the Look Ahead Display. The user station 52 may allow the user to preset the key pads 57, such as via a web page preferences page, so that the key pads correspond to the user's particular preferences. The use of key pads to select the mode in which information is displayed has several advantages. The key pads eliminate fumbling by the commuter, and thus are safer to use than a keyboard. They keypads also allow the user to quickly move between different types of modes of presentation, so that the commuter may maximize the amount of information received.

When using data from individual mobile user stations 52 to determine traffic information, it may be desirable to screen the data to determine whether it will be included in the traffic information database. One type of screening may involve comparing the geographic location of the user with particular features stored in the map database. For example, where the user is located at a stop sign, it may not be desirable to include the user's reported velocity in the database. The computer system 40 may be programmed so that data received from users at stop signs will not be added to the traffic database. Accordingly, when the user reports its geographic location, the computer system 40 compares the geographic location of the user with the map database. When the computer system 40 determines that the user is located at a stop sign (or other location, as desired), the data is rejected. Thus, the vehicle speed data transmitted by the user is screened based on the particular location of the user.

It may also be desirable to screen out data from users that are not traveling along roads of interest. For example, the computer system 40 may maintain a limited traffic information database that only stores traffic information for selected major roads.

Thus, the traffic information database may contain data for fewer roads than contained in the map database. If a user is traveling along a side street which is not included in the traffic information database, the data received from the user is rejected or otherwise not used. Thus, the computer system 40 compares the geographic location of the user with the geographic locations of the roads maintained in the traffic information database. If the user reports a location that is not on a road for which traffic information is maintained in the traffic information database, the user's particular traffic information is rejected.

Another type of screening that may be desired is to compare the direction of travel of each user with the direction of travel on various roads before adding the user's vehicle speed to the traffic information database. This may be particularly important where the resolution of the GPS receiver 62 is such that the location of the user may be confused with one or more roads. For example, a user may be traveling along a divided road with lanes of traffic traveling in opposite directions, but the resolution of the GPS receiver 62 does not allow the computer system 40 to determine with confidence in which lane the user's vehicle is traveling. In order to determine what portion of the traffic information database to update, the computer system 40 and/or user station 52 creates a directional vector associated with the user which represents the user's direction of travel. The directional vector is determined based on the movement over time by the user. For example, the directional vector may be represented by a number ranging from 0-359; with 0° representing travel straight north, 90° straight east, etc. When information is received by the computer system 40, it compares the directions of travel of the various roads near the geographic location of the user with the user's directional vector. For example, the geographic

information reported by the GPS receiver 62 indicates that the user is located near a particular road that has north/south lanes with traffic traveling in each direction. The user's directional vector indicates that the user is traveling south. The computer system 40 therefore updates the traffic information database to add the data received from the user to the traffic information database for the lanes of traffic moving in the user's direction of travel. Other instances in which the directional vector would be useful would be where a user is crossing a particular road, such as when traveling along an overpass or an underpass, and the resolution of the GPS receiver is such that the computer system 40 is unable to determine with confidence on which road the user is traveling. The use of the directional vector thus prevents the computer system 40 from incorrectly updating the traffic information database. In addition, the altitude component of the GPS data may be used to discriminate between users on overpasses or roads that are vertically offset from one another.

Yet another type of screening may be necessary where the user reports no movement. In this instance, it may be desirable to determine whether the user's data should be added to the database, because the user may be stopped along the side of the road while traffic is nevertheless moving. Thus, the computer system 40, when it receives data from a user indicating that the user has not moved since the last time the user reported data, may cross check the data through a variety of algorithms. For example, the computer system 40 may compare the data reported by the user with the traffic information for that portion of the road determined from data taken from sensors and/or other mobile users. If the traffic information derived from other sources indicates that traffic is moving along the road, the no movement data received from the particular user would be rejected. Alternatively, the computer system 40 may be associated

with a system that allows a user to request assistance in the event of a breakdown. The computer system 40 could check to see whether the user has reported a breakdown, and if so, reject the traffic data.

5 Yet another method for filtering data is to screen data received from particular users and/or classes of devices which are capable of functioning as user stations. For example, it may be desirable to exclude traffic data received from buses, because buses do not
10 provide representative velocity data due to frequent stops. Thus all data from buses could be excluded. Alternatively, data from particular types of user stations could be excluded. For example, the computer system 40 could maintain a database of the particular
15 types of devices used by different users. Because data from hand held devices may not correspond to a vehicle moving along a road, the computer system 40 may reject data from the class of hand held computing devices. Thus the system could distinguish between different classes of
20 users and/or user stations 52 to determine whether to accept traffic data from that user station.

In another embodiment, the present inventors came to the realization that merely encoding the image with a representation of the traffic flow relative to a
25 single fixed value is not optimal. An example of such coding would be red is 0-30 mph, yellow is 30-40 mph, and green is 40+ mph. This coding is adequate for freeways but when roads are encoded that have lower speed limits, the encoding should be relative to what the speed limit
30 is so that the user knows the relative speed of traffic on the road. Thus coding may correspond to relative speed rather than absolute speed. For example, a freeway with speed limit 55 mph would be coded 0-30 mph red, 30-40 mph yellow and 40+ mph green, while a side road with a
35 35 mph speed limit would be coded 0-20 mph red, 20-25 mph yellow and 25+ mph green. This permits relative encoding which is easier to interpret. Alternatively, encoding

may be based on other relative measures, such as for example, anticipated traffic flow for that particular road, section of road, time of day, and statistical history measure of traffic in the past. When multiple
 5 freeways in the area are all busy, such as Seattle, coding for absolute values may show everything as red. However, if relative coding is used, the traffic flow may be relative to other roads so that the encoding dynamically adjusts to encode one road relative to one or
 10 more other roads. In this manner, for example, the "fast" road may be green and the "slow" road may be red.

While the present invention has been described in the context of providing traffic information, the present invention may also be used to provide location
 15 specific information to mobile users. In one such embodiment, an information database may be created for weather reports, in which various weather reports are associated with respective geographic locations. A user in a vehicle 60 may request a weather report from the
 20 mobile user station 52. The request would include the user's geographic location as determined by the GPS receiver 62. In response to the request, the computer system would access the weather database and select the weather report associated with that geographic location.
 25 The location specific weather report would then be transmitted to the mobile user station 52. The weather report would then be displayed or otherwise communicated to the user through speakers. Other similar information databases could likewise be prepared to associate
 30 particular information with geographic locations. In this manner, a user at a mobile user station 52 may easily obtain highly relevant information that is specific to the location of the user. In preferred embodiments of the system, the user may receive both
 35 traffic information and other location specific information at the same time, in sequence, or as requested by the user. In one such embodiment, the user

may preselect the information to be retrieved and the sequence of display or communication.

The terms and expressions which have been employed in the foregoing specification are used therein as terms of description and not of limitation, and there is no intention, in the use of such terms and expressions, of excluding equivalents of the features shown and described or portions thereof, it being recognized that the scope of the invention is defined and limited only by the claims which follow.

11 12
13 14
15 16
17 18
19 20
21 22
23 24
25 26
27 28
29 30
31 32
33 34
35 36
37 38
39 40
41 42
43 44
45 46
47 48
49 50
51 52
53 54
55 56
57 58
59 60
61 62
63 64
65 66
67 68
69 70
71 72
73 74
75 76
77 78
79 80
81 82
83 84
85 86
87 88
89 90
91 92
93 94
95 96
97 98
99 100
101 102
103 104
105 106
107 108
109 110
111 112
113 114
115 116
117 118
119 120
121 122
123 124
125 126
127 128
129 130
131 132
133 134
135 136
137 138
139 140
141 142
143 144
145 146
147 148
149 150
151 152
153 154
155 156
157 158
159 160
161 162
163 164
165 166
167 168
169 170
171 172
173 174
175 176
177 178
179 180
181 182
183 184
185 186
187 188
189 190
191 192
193 194
195 196
197 198
199 200
201 202
203 204
205 206
207 208
209 210
211 212
213 214
215 216
217 218
219 220
221 222
223 224
225 226
227 228
229 230
231 232
233 234
235 236
237 238
239 240
241 242
243 244
245 246
247 248
249 250
251 252
253 254
255 256
257 258
259 260
261 262
263 264
265 266
267 268
269 270
271 272
273 274
275 276
277 278
279 280
281 282
283 284
285 286
287 288
289 290
291 292
293 294
295 296
297 298
299 300
301 302
303 304
305 306
307 308
309 310
311 312
313 314
315 316
317 318
319 320
321 322
323 324
325 326
327 328
329 330
331 332
333 334
335 336
337 338
339 340
341 342
343 344
345 346
347 348
349 350
351 352
353 354
355 356
357 358
359 360
361 362
363 364
365 366
367 368
369 370
371 372
373 374
375 376
377 378
379 380
381 382
383 384
385 386
387 388
389 390
391 392
393 394
395 396
397 398
399 400
401 402
403 404
405 406
407 408
409 410
411 412
413 414
415 416
417 418
419 420
421 422
423 424
425 426
427 428
429 430
431 432
433 434
435 436
437 438
439 440
441 442
443 444
445 446
447 448
449 450
451 452
453 454
455 456
457 458
459 460
461 462
463 464
465 466
467 468
469 470
471 472
473 474
475 476
477 478
479 480
481 482
483 484
485 486
487 488
489 490
491 492
493 494
495 496
497 498
499 500
501 502
503 504
505 506
507 508
509 510
511 512
513 514
515 516
517 518
519 520
521 522
523 524
525 526
527 528
529 530
531 532
533 534
535 536
537 538
539 540
541 542
543 544
545 546
547 548
549 550
551 552
553 554
555 556
557 558
559 560
561 562
563 564
565 566
567 568
569 570
571 572
573 574
575 576
577 578
579 580
581 582
583 584
585 586
587 588
589 590
591 592
593 594
595 596
597 598
599 600
601 602
603 604
605 606
607 608
609 610
611 612
613 614
615 616
617 618
619 620
621 622
623 624
625 626
627 628
629 630
631 632
633 634
635 636
637 638
639 640
641 642
643 644
645 646
647 648
649 650
651 652
653 654
655 656
657 658
659 660
661 662
663 664
665 666
667 668
669 670
671 672
673 674
675 676
677 678
679 680
681 682
683 684
685 686
687 688
689 690
691 692
693 694
695 696
697 698
699 700
701 702
703 704
705 706
707 708
709 710
711 712
713 714
715 716
717 718
719 720
721 722
723 724
725 726
727 728
729 730
731 732
733 734
735 736
737 738
739 740
741 742
743 744
745 746
747 748
749 750
751 752
753 754
755 756
757 758
759 760
761 762
763 764
765 766
767 768
769 770
771 772
773 774
775 776
777 778
779 780
781 782
783 784
785 786
787 788
789 790
791 792
793 794
795 796
797 798
799 800
801 802
803 804
805 806
807 808
809 810
811 812
813 814
815 816
817 818
819 820
821 822
823 824
825 826
827 828
829 830
831 832
833 834
835 836
837 838
839 840
841 842
843 844
845 846
847 848
849 850
851 852
853 854
855 856
857 858
859 860
861 862
863 864
865 866
867 868
869 870
871 872
873 874
875 876
877 878
879 880
881 882
883 884
885 886
887 888
889 890
891 892
893 894
895 896
897 898
899 900
901 902
903 904
905 906
907 908
909 910
911 912
913 914
915 916
917 918
919 920
921 922
923 924
925 926
927 928
929 930
931 932
933 934
935 936
937 938
939 940
941 942
943 944
945 946
947 948
949 950
951 952
953 954
955 956
957 958
959 960
961 962
963 964
965 966
967 968
969 970
971 972
973 974
975 976
977 978
979 980
981 982
983 984
985 986
987 988
989 990
991 992
993 994
995 996
997 998
999 1000
1001 1002
1003 1004
1005 1006
1007 1008
1009 1010
1011 1012
1013 1014
1015 1016
1017 1018
1019 1020
1021 1022
1023 1024
1025 1026
1027 1028
1029 1030
1031 1032
1033 1034
1035 1036
1037 1038
1039 1040
1041 1042
1043 1044
1045 1046
1047 1048
1049 1050
1051 1052
1053 1054
1055 1056
1057 1058
1059 1060
1061 1062
1063 1064
1065 1066
1067 1068
1069 1070
1071 1072
1073 1074
1075 1076
1077 1078
1079 1080
1081 1082
1083 1084
1085 1086
1087 1088
1089 1090
1091 1092
1093 1094
1095 1096
1097 1098
1099 1100
1101 1102
1103 1104
1105 1106
1107 1108
1109 1110
1111 1112
1113 1114
1115 1116
1117 1118
1119 1120
1121 1122
1123 1124
1125 1126
1127 1128
1129 1130
1131 1132
1133 1134
1135 1136
1137 1138
1139 1140
1141 1142
1143 1144
1145 1146
1147 1148
1149 1150
1151 1152
1153 1154
1155 1156
1157 1158
1159 1160
1161 1162
1163 1164
1165 1166
1167 1168
1169 1170
1171 1172
1173 1174
1175 1176
1177 1178
1179 1180
1181 1182
1183 1184
1185 1186
1187 1188
1189 1190
1191 1192
1193 1194
1195 1196
1197 1198
1199 1200
1201 1202
1203 1204
1205 1206
1207 1208
1209 1210
1211 1212
1213 1214
1215 1216
1217 1218
1219 1220
1221 1222
1223 1224
1225 1226
1227 1228
1229 1230
1231 1232
1233 1234
1235 1236
1237 1238
1239 1240
1241 1242
1243 1244
1245 1246
1247 1248
1249 1250
1251 1252
1253 1254
1255 1256
1257 1258
1259 1260
1261 1262
1263 1264
1265 1266
1267 1268
1269 1270
1271 1272
1273 1274
1275 1276
1277 1278
1279 1280
1281 1282
1283 1284
1285 1286
1287 1288
1289 1290
1291 1292
1293 1294
1295 1296
1297 1298
1299 1300
1301 1302
1303 1304
1305 1306
1307 1308
1309 1310
1311 1312
1313 1314
1315 1316
1317 1318
1319 1320
1321 1322
1323 1324
1325 1326
1327 1328
1329 1330
1331 1332
1333 1334
1335 1336
1337 1338
1339 1340
1341 1342
1343 1344
1345 1346
1347 1348
1349 1350
1351 1352
1353 1354
1355 1356
1357 1358
1359 1360
1361 1362
1363 1364
1365 1366
1367 1368
1369 1370
1371 1372
1373 1374
1375 1376
1377 1378
1379 1380
1381 1382
1383 1384
1385 1386
1387 1388
1389 1390
1391 1392
1393 1394
1395 1396
1397 1398
1399 1400
1401 1402
1403 1404
1405 1406
1407 1408
1409 1410
1411 1412
1413 1414
1415 1416
1417 1418
1419 1420
1421 1422
1423 1424
1425 1426
1427 1428
1429 1430
1431 1432
1433 1434
1435 1436
1437 1438
1439 1440
1441 1442
1443 1444
1445 1446
1447 1448
1449 1450
1451 1452
1453 1454
1455 1456
1457 1458
1459 1460
1461 1462
1463 1464
1465 1466
1467 1468
1469 1470
1471 1472
1473 1474
1475 1476
1477 1478
1479 1480
1481 1482
1483 1484
1485 1486
1487 1488
1489 1490
1491 1492
1493 1494
1495 1496
1497 1498
1499 1500
1501 1502
1503 1504
1505 1506
1507 1508
1509 1510
1511 1512
1513 1514
1515 1516
1517 1518
1519 1520
1521 1522
1523 1524
1525 1526
1527 1528
1529 1530
1531 1532
1533 1534
1535 1536
1537 1538
1539 1540
1541 1542
1543 1544
1545 1546
1547 1548
1549 1550
1551 1552
1553 1554
1555 1556
1557 1558
1559 1560
1561 1562
1563 1564
1565 1566
1567 1568
1569 1570
1571 1572
1573 1574
1575 1576
1577 1578
1579 1580
1581 1582
1583 1584
1585 1586
1587 1588
1589 1590
1591 1592
1593 1594
1595 1596
1597 1598
1599 1600
1601 1602
1603 1604
1605 1606
1607 1608
1609 1610
1611 1612
1613 1614
1615 1616
1617 1618
1619 1620
1621 1622
1623 1624
1625 1626
1627 1628
1629 1630
1631 1632
1633 1634
1635 1636
1637 1638
1639 1640
1641 1642
1643 1644
1645 1646
1647 1648
1649 1650
1651 1652
1653 1654
1655 1656
1657 1658
1659 1660
1661 1662
1663 1664
1665 1666
1667 1668
1669 1670
1671 1672
1673 1674
1675 1676
1677 1678
1679 1680
1681 1682
1683 1684
1685 1686
1687 1688
1689 1690
1691 1692
1693 1694
1695 1696
1697 1698
1699 1700
1701 1702
1703 1704
1705 1706
1707 1708
1709 1710
1711 1712
1713 1714
1715 1716
1717 1718
1719 1720
1721 1722
1723 1724
1725 1726
1727 1728
1729 1730
1731 1732
1733 1734
1735 1736
1737 1738
1739 1740
1741 1742
1743 1744
1745 1746
1747 1748
1749 1750
1751 1752
1753 1754
1755 1756
1757 1758
1759 1760
1761 1762
1763 1764
1765 1766
1767 1768
1769 1770
1771 1772
1773 1774
1775 1776
1777 1778
1779 1780
1781 1782
1783 1784
1785 1786
1787 1788
1789 1790
1791 1792
1793 1794
1795 1796
1797 1798
1799 1800
1801 1802
1803 1804
1805 1806
1807 1808
1809 1810
1811 1812
1813 1814
1815 1816
1817 1818
1819 1820
1821 1822
1823 1824
1825 1826
1827 1828
1829 1830
1831 1832
1833 1834
1835 1836
1837 1838
1839 1840
1841 1842
1843 1844
1845 1846
1847 1848
1849 1850
1851 1852
1853 1854
1855 1856
1857 1858
1859 1860
1861 1862
1863 1864
1865 1866
1867 1868
1869 1870
1871 1872
1873 1874
1875 1876
1877 1878
1879 1880
1881 1882
1883 1884
1885 1886
1887 1888
1889 1890
1891 1892
1893 1894
1895 1896
1897 1898
1899 1900
1901 1902
1903 1904
1905 1906
1907 1908
1909 1910
1911 1912
1913 1914
1915 1916
1917 1918
1919 1920
1921 1922
1923 1924
1925 1926
1927 1928
1929 1930
1931 1932
1933 1934
1935 1936
1937 1938
1939 1940
1941 1942
1943 1944
1945 1946
1947 1948
1949 1950
1951 1952
1953 1954
1955 1956
1957 1958
1959 1960
1961 1962
1963 1964
1965 1966
1967 1968
1969 1970
1971 1972
1973 1974
1975 1976
1977 1978
1979 1980
1981 1982
1983 1984
1985 1986
1987 1988
1989 1990
1991 1992
1993 1994
1995 1996
1997 1998
1999 2000
2001 2002
2003 2004
2005 2006
2007 2008
2009 2010
2011 2012
2013 2014
2015 2016
2017 2018
2019 2020
2021 2022
2023 2024
2025 2026
2027 2028
2029 2030
2031 2032
2033 2034
2035 2036
2037 2038
2039 2040
2041 2042
2043 2044
2045 2046
2047 2048
2049 2050
2051 2052
2053 2054
2055 2056
2057 2058
2059 2060
2061 2062
2063 2064
2065 2066
2067 2068
2069 2070
2071 2072
2073 2074
2075 2076
2077 2078
2079 2080
2081 2082
2083 2084
2085 2086
2087 2088
2089 2090
2091 2092
2093 2094
2095 2096
2097 2098
2099 2100
2101 2102
2103 2104
2105 2106
2107 2108
2109 2110
2111 2112
2113 2114
2115 2116
2117 2118
2119 2120
2121 2122
2123 2124
2125 2126
2127 2128
2129 2130
2131 2132
2133 2134
2135 2136
2137 2138
2139 2140
2141 2142
2143 2144
2145 2146
2147 2148
2149 2150
2151 2152
2153 2154
2155 2156
2157 2158
2159 2160
2161 2162
2163 2164
2165 2166
2167 2168
2169 2170
2171 2172
2173 2174
2175 2176
2177 2178
2179 2180
2181 2182
2183 2184
2185 2186
2187 2188
2189 2190
2191 2192
2193 2194
2195 2196
2197 2198
2199 2200
2201 2202
2203 2204
2205 2206
2207 2208
2209 2210
2211 2212
2213 2214
2215 2216
2217 2218
2219 2220
2221 2222
2223 2224
2225 2226
2227 2228
2229 2230
2231 2232
2233 2234
2235 2236
2237 2238
2239 2240
2241 2242
2243 2244
2245 2246
2247 2248
2249 2250
2251 2252
2253 2254
2255 2256
2257 2258
2259 2260
2261 2262
2263 2264
2265 2266
2267 2268
2269 2270
2271 2272
2273 2274
2275 2276
2277 2278
2279 2280
2281 2282
2283 2284
2285 2286
2287 2288
2289 2290
2291 2292
2293 2294
2295 2296
2297 2298
2299 2300
2301 2302
2303 2304
2305 2306
2307 2308
2309 2310
2311 2312
2313 2314
2315 2316
2317 2318
2319 2320
2321 2322
2323 2324
2325 2326
2327 2328
2329 2330
2331 2332
2333 2334
2335 2336
2337 2338
2339 2340
2341 2342
2343 2344
2345 2346
2347 2348
2349 2350
2351 2352
2353 2354
2355 2356
2357 2358
2359 2360
2361 2362
2363 2364
2365 2366
2367 2368
2369 2370
2371 2372
2373 2374
2375 2376
2377 2378
2379 2380
2381 2382
2383 2384
2385 2386
2387 2388
2389 2390
2391 2392
2393 2394
2395 2396
2397 2398
2399 2400
2401 2402
2403 2404
2405 2406
2407 2408
2409 2410
2411 2412
2413 2414
2415 2416
2417 2418

CLAIMS

1. A system for providing traffic information to a plurality of mobile users connected to a network,
5 comprising:

- (a) a plurality of traffic monitors, each said traffic monitor comprising at least a detector and a transmitter, said detector providing a signal including data
10 representative of vehicular movement and said transmitter transmitting said signals;
- (b) a receiver that receives said signals transmitted by said traffic monitors; and
- 15 (c) a computer system interconnected with said receiver and said network;
- (d) a mobile user station connected to a global positioning system receiver, a display, and a communicating device; and
- 20 (e) said computer system, in response to a request for traffic information from one of said mobile user stations, providing in response thereto to said one of said mobile user stations traffic information
25 representative of said signals transmitted by said traffic monitors.

2. The system of claim 1 wherein said traffic information transmitted by said computer system is
30 displayed graphically on said display.

3. The system of claim 2 wherein said traffic information is displayed together with a video image.

35 4. The system of claim 2 wherein said traffic information is displayed with a text message.

5. The system of claim 2 wherein said computer system has a map database, and said computer system, in response to said request for information, transmits map information representative of a portion of said map database, and said map information representative of said map database is displayed graphically together with said traffic information.

6. The system of claim 1 wherein said traffic detector detects vehicular speed.

7. The system of claim 1 wherein at least one of said transmitters transmits directly to said receiver.

8. The system of claim 1 wherein at least one of said transmitters transmits to another traffic monitor.

9. The system of claim 1 wherein at least one of said traffic monitors includes a video camera.

10. The system of claim 9 wherein said detector is a video camera.

11. The system of claim 1 wherein said user provides latitude and longitude information to said computer system.

12. The system of claim 1 wherein said computer system selects said traffic information to provide to said mobile user station based on a signal received from said global positioning system receiver.

13. The system of claim 12 wherein said computer system maintains a traffic information database containing data representative of traffic at a plurality of locations and updates said traffic information

database in response to signals received from said mobile user station.

14. The system of claim 13 wherein said mobile user station displays both the location of said mobile user station and traffic information graphically on said display.

15 15. The system of claim 14 wherein said mobile user station has an input mechanism to select a mode in which traffic information is shown on said display.

16. A system for providing traffic information to a plurality of mobile users connected to a network, comprising:

- 15 (a) a plurality of vehicles, each said vehicle comprising at least a mobile user station, a global positioning system receiver and a transmitter, said mobile user station providing a signal including data representative of a location of said mobile user station and at least one of a speed of said vehicle and an identification code of said mobile user station and said transmitter transmitting said signal;
- 20 (b) a receiver that receives said signals transmitted by said user stations; and
- 25 (c) a computer system interconnected with said receiver and said network, said computer system, in response to a request for information from one of said mobile user stations, providing in response thereto to said one of said mobile user stations information representative of said signals transmitted by said mobile user stations.
- 30
- 35

17. The system of claim 16 wherein said vehicle further comprises a display and said information transmitted by said computer system is displayed graphically on said display.

18. The system of claim 17 wherein said computer system has a map database, and said computer system, in response to said request for information, transmits information representative of a portion of said map database, and said information representative of said map database is displayed graphically.

19. The system of claim 16 wherein said computer system maintains a traffic information database containing information representative of traffic at a plurality of locations and updates said traffic information database in response to signals received from stationary traffic monitors.

20. The system of claim 17 wherein the location of said one of said mobile user stations is displayed graphically on said display together with said traffic information provided by said computer system.

21. The system of claim 17 wherein said mobile user station has an input mechanism to select different modes of displaying traffic information on said display.

22. The system of claim 20 wherein said location of said vehicle is shown at a point on said display regardless of movement of said vehicle.

23. The system of claim 20 wherein said displayed location of said vehicle depends on said location of said vehicle, so that the displayed location changes as the vehicle's location changes.

24. The system of claim 19 wherein said computer system screens data provided by said mobile user stations to determine before updating said traffic information database.

25. A system for providing traffic information to a plurality of mobile users connected to a network, comprising:

- 10 (a) a plurality of mobile user stations, each mobile user station being associated with a display, a global positioning system receiver and a communicating device to allow each of said mobile user stations to send and receive signals;
- 15 (b) a computer system interconnected with another communicating device and a network, said computer system being capable of sending and receiving signals to and from said mobile user stations;
- 20 (c) said computer system including a map database and a traffic information database, said traffic information database containing data representative of traffic at a plurality of locations;
- 25 (d) at least one of said mobile user stations providing a request to said computer system for information together with a respective geographic location of said one of said mobile user stations, and in response thereto, said computer system providing to said one of said mobile user stations information representative of selected portions of said map database and selected portions of said traffic information database based on said
30 respective geographic location of said one of said mobile user stations; and
35

(e) said one of said mobile user stations displaying graphically on said display information representative of said selected portions of said map database and said selected portions of said traffic information database.

26. The system of claim 25 wherein said computer system is connected to a plurality of traffic monitors, and said traffic information database contains data derived from said traffic monitors.

27. The system of claim 25 wherein said computer system updates said traffic information database based on data received from said mobile user stations.

28. The system of claim 26 wherein said computer system updates said traffic information database based on data received from said mobile user stations.

29. The system of claim 28 wherein said computer system compares data from said mobile user stations with said data derived from said traffic monitors before updating said traffic information database.

30. The system of claim 25 wherein said map database contains longitude and latitude information for locations within said database.

31. The system of claim 30 wherein said traffic information database and map database are integrated using said longitude and latitude information.

32. The system of claim 31 wherein each said mobile user station provides longitude and latitude information to said computer system.

33. The system of claim 25 wherein said computer system transmits information which is displayed as an information banner on said display.

34. The system of claim 25 wherein said mobile user stations each have an input mechanism for selecting the mode of displaying information on said display.

35. The system of claim 25 wherein said location of said one of said mobile user stations is displayed graphically.

36. The system of claim 35 wherein said displayed location of said one of said mobile user stations changes based on movement of said mobile user station.

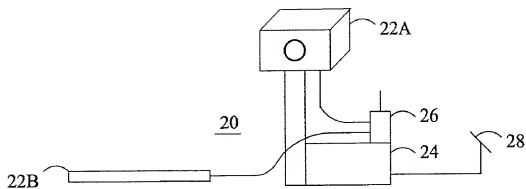
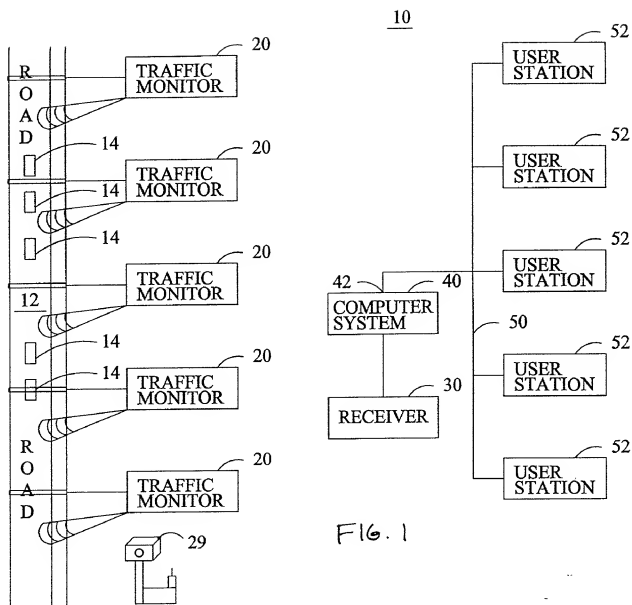
37. The system of claim 25 wherein said computer system screens data provided by said mobile user stations to determine whether said data corresponds to actual traffic conditions.

38. The system of claim 25 wherein said computer system compares data provided from said one of said mobile user stations with said map database before updating said traffic information database.

SYSTEM FOR PROVIDING TRAFFIC INFORMATION

ABSTRACT OF THE DISCLOSURE

A system for providing traffic information to a plurality of mobile users connected to a network. The system comprises a plurality of traffic monitors, each comprising at least a traffic detector and a transmitter, the traffic detector generating a signal in response to vehicular traffic and the transmitter transmitting the signal. A receiver receives the signals from the traffic monitors. A computer system is connected to the receiver and is further connected to the network. The computer system in response to a request signal received from one of the users transmits in response thereto information representative of the signals transmitted by the traffic monitoring units. Alternative systems for gathering traffic information are disclosed.



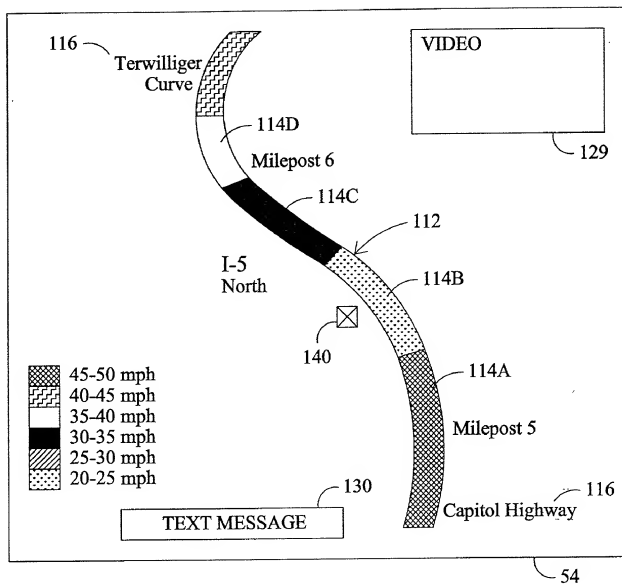


FIG. 3

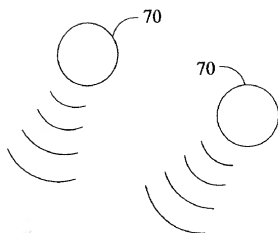
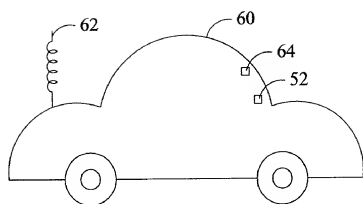


FIG. 4

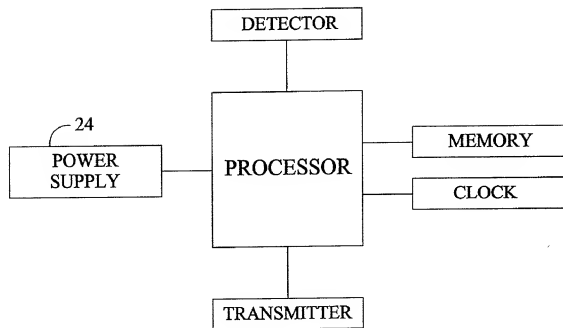


FIG. 5

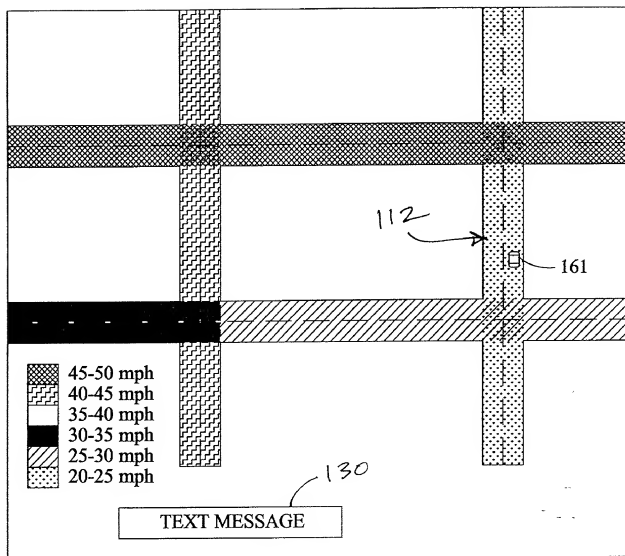


FIG. 6

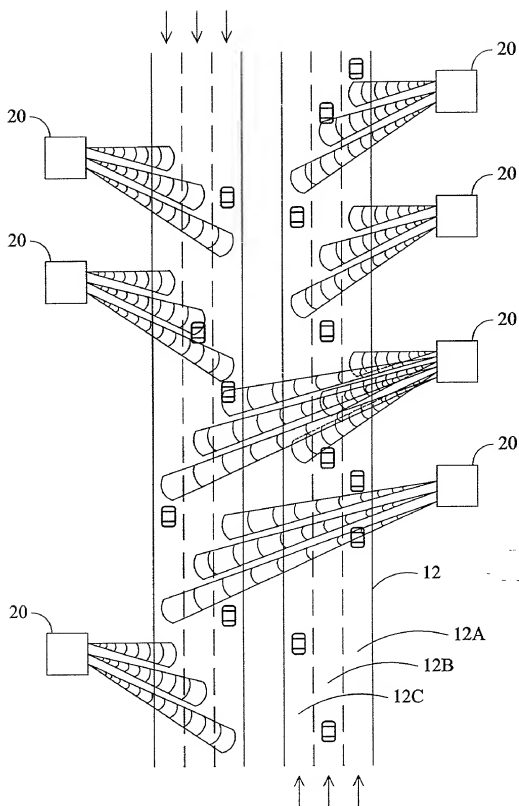


FIG. 7

54

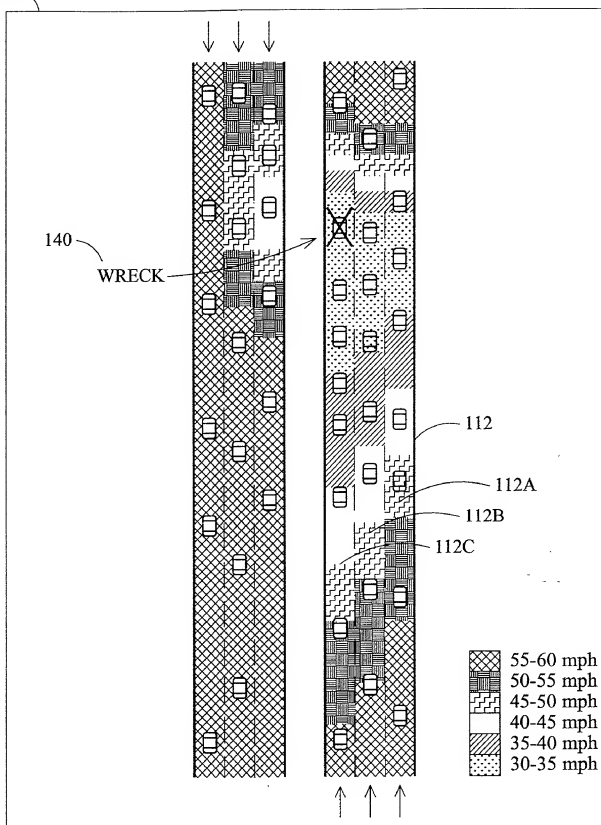


FIG. 8

FIG. 9

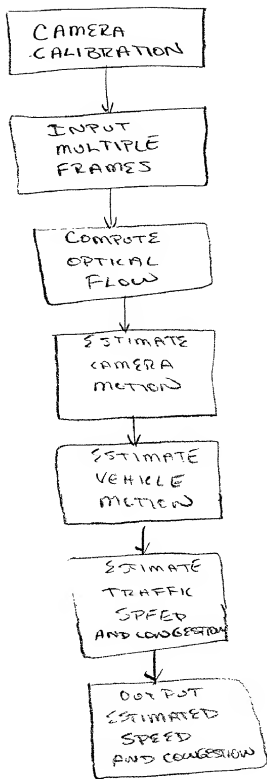
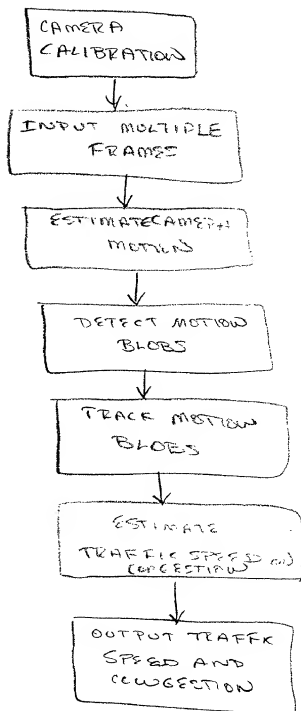


Fig. 10



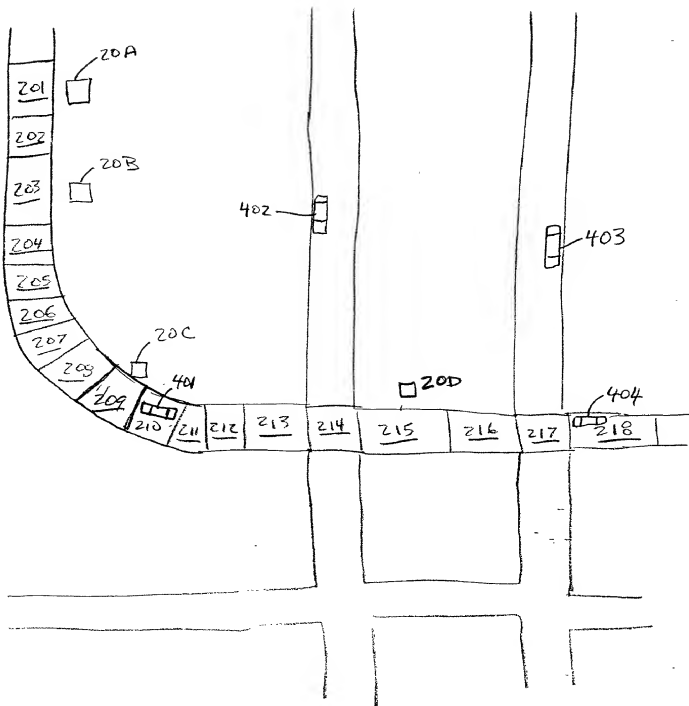


FIG. 11

LOCATION	LAT/LONG	ROAD	DIRECTION	VELOCITY
201	45°54'36"N 37°32'12"E	INTERSTATE	0°	55 MPH
202	°	LOCAL	27°	20 MPH
203	°	BYPASS	EAST	STOPPED
204	°	RESIDENTIAL	NW	:
205	°	°	°	:
206				
207				
°				
°				
°				

FIG. 12

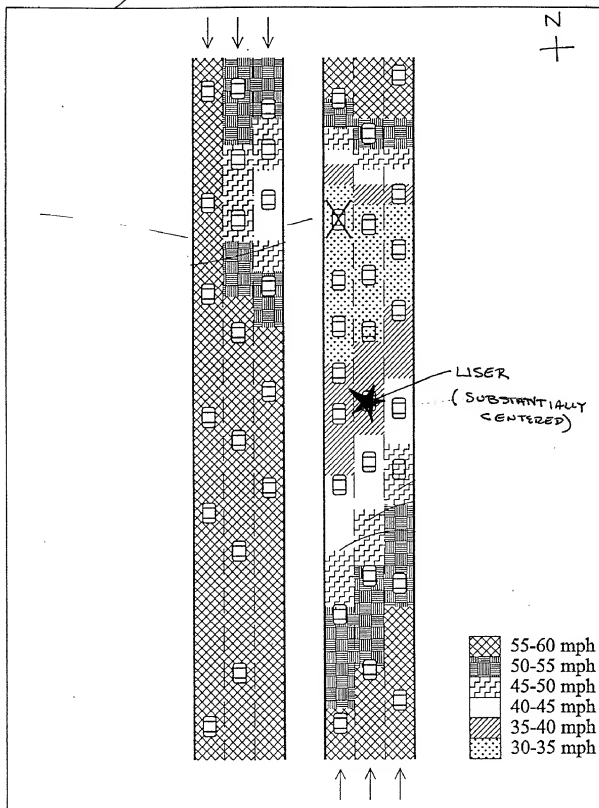


FIG. 13

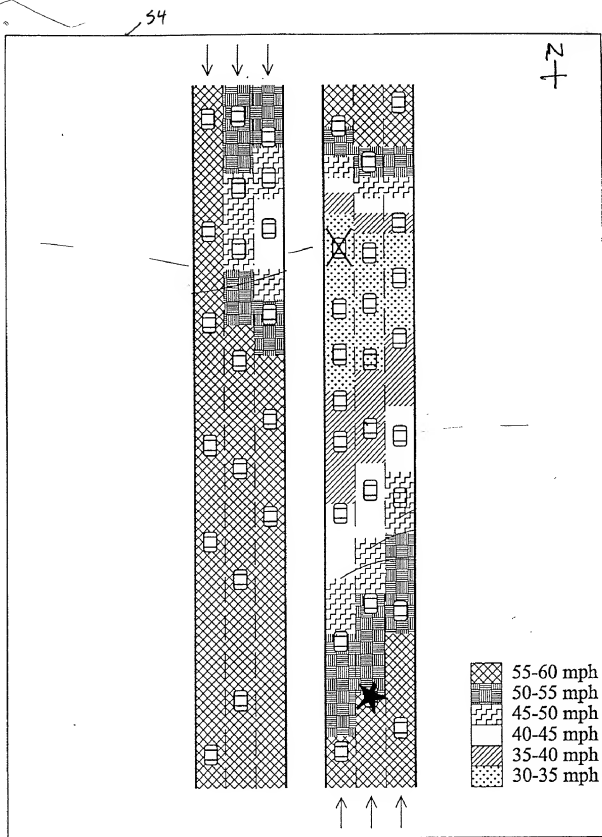
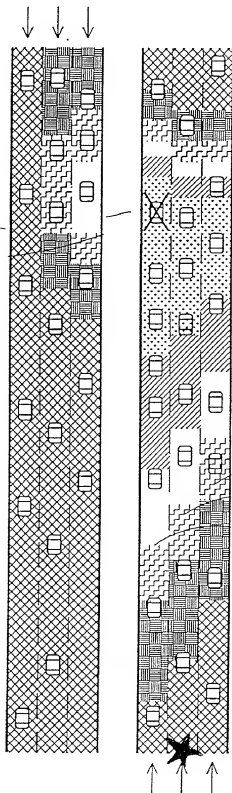


FIG. 14

54

2+



F16.15

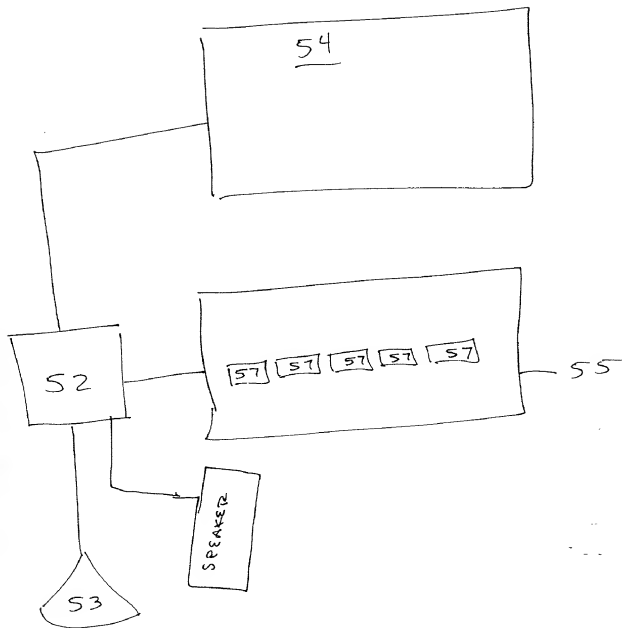


FIG. 16

DECLARATION AND POWER OF ATTORNEY

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name,

I believe I am an original, first and joint inventor of the subject matter which is claimed and for which a patent is sought on the invention entitled:

SYSTEM FOR PROVIDING TRAFFIC INFORMATION

the specification of which

☒ is attached hereto.

☐ was filed on _____ as
Application Serial No. _____
and was amended on _____
(if applicable)

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claim(s), as amended by any amendment referred to above.

I acknowledge the duty to disclose information which is material to the examination of this application in accordance with Title 37, Code of Federal Regulations, §1.56.

I hereby claim foreign priority benefits under Title 35, United States Code, §119 of any foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application for patent or inventor's certificate having a filing date before that of the application on which priority is claimed:

Prior Foreign Application(s)

Priority
Claimed

_____ (Number)	_____ (Country)	_____ (Day/Month/Year Filed)	<input type="checkbox"/> Yes <input type="checkbox"/> No
_____ (Number)	_____ (Country)	_____ (Day/Month/Year Filed)	<input type="checkbox"/> Yes <input type="checkbox"/> No
_____ (Number)	_____ (Country)	_____ (Day/Month/Year Filed)	<input type="checkbox"/> Yes <input type="checkbox"/> No

I hereby claim the benefit under 35 U.S.C. §119(e) of any United States provisional application(s) listed below.

<u>60/130,399</u> (Application Serial No.)	<u>4/19/99</u> (Filing Date)
<u>60/166,868</u> (Application Serial No.)	<u>11/22/99</u> (Filing Date)
<u>60/189,913</u> (Application Serial No.)	<u>3/16/00</u> (Filing Date)

I hereby claim the benefit under Title 35, United States Code, §120, of any United States application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of Title 35, United States Code, §112, I acknowledge the duty to disclose material information as defined in Title 37, Code of Federal Regulations, §1.56 which occurred between the filing date of the prior application and the national or PCT international filing date of this application:

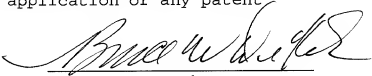
(Application Ser. No.)	(Filing Date)	(Status) (patented, pending, abandoned)
------------------------	---------------	---

(Application Ser. No.)	(Filing Date)	(Status) (patented, pending, abandoned)
------------------------	---------------	---

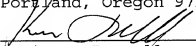
I hereby appoint Jacob E. Vilhauer, Jr., Reg. No. 24,885, Charles D. McClung, Reg. No. 26,568, Dennis E. Stenzel, Reg. No. 28,763, Donald B. Haslett, Reg. No. 28,855, William O. Geny, Reg. No. 27,444, J. Peter Staples, Reg. No. 30,690, Nancy J. Moriarty, Reg. No. 40,733, Kevin L. Russell, Reg. No. 38,292, Bruce W. DeKock, Reg. No. 40,585, and Timothy A. Long, Reg. No. 28,876, all of the firm of CHERNOFF, VILHAUER, MCCLUNG & STENZEL, L.L.P., 1600 ODS Tower, 601 S.W. Second Avenue, Portland, Oregon 97204, telephone No. (503) 227-5631, my attorneys, jointly and individually, to prosecute this application and to transact all business in the Patent and Trademark Office connected therewith.

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Dated: 4/13/00
Full name of 1st joint inventor
Residence
Citizenship
Post Office Address


Bruce W. DeKock
Portland, Oregon
U.S.A.
8850 S.W. 71st Place
Portland, Oregon 97223

Dated: 4/13/00
Full name of 2nd joint inventor
Residence
Citizenship
Post Office Address


Kevin L. Russell
Portland, Oregon
U.S.A.
2910 SW Collins Court
Portland, Oregon 97219

Dated: 4-12-00
Full name of 3rd joint inventor
Residence
Citizenship
Post Office Address

Richard J. Qian
Richard J. Qian
Camas, Washington
~~U.S.A.~~ CHINA
2844 N.W. 44th Ave.
Camas, Washington 98607

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60
61
62
63
64
65
66
67
68
69
70
71
72
73
74
75
76
77
78
79
80
81
82
83
84
85
86
87
88
89
90
91
92
93
94
95
96
97
98
99
100